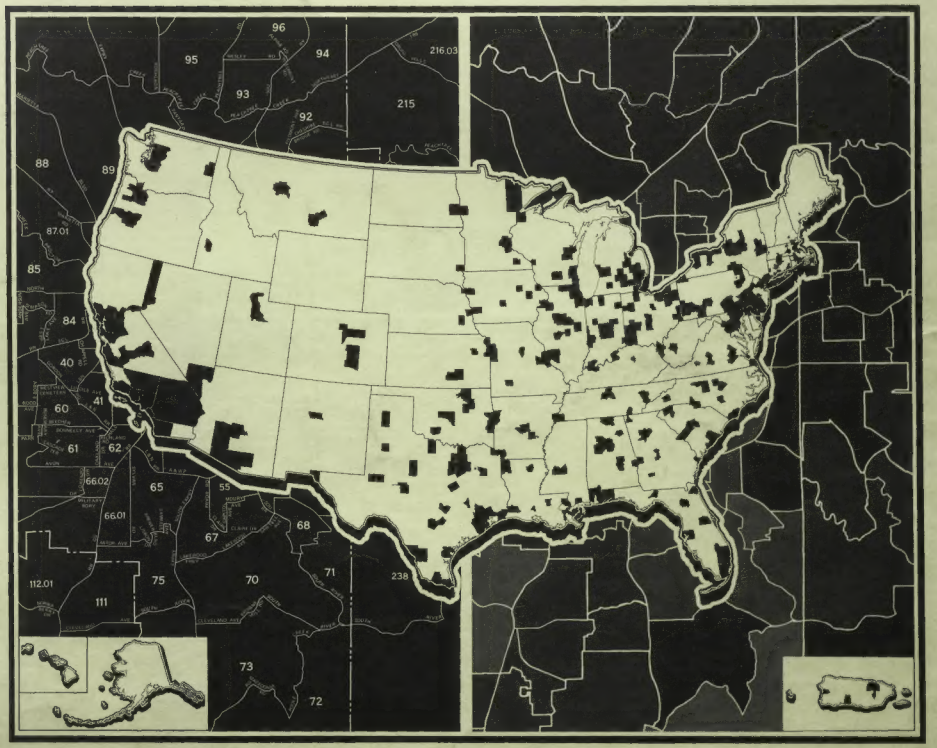
URBAN ATLAS

TRACT DATA FOR STANDARD METROPOLITAN STATISTICAL AREAS



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The development of the computerized geographic files describing the location and shape of the census tracts was a joint endeavor of the Bureau of the Census; the Department of Labor, Manpower Administration; and the Department of Housing and Urban Development, utilizing the facilities and expertise of the Lawrence Berkeley Laboratory of the University of California at Berkeley. The project directors for the participants were Morton A. Meyer and Richard H. Schweitzer, Jr., Bureau of the Census; Walter Postle and Bruce Bargmeyer, Manpower Administration, Region IX; Marilyn Fine, Department of Housing and Urban Development; and Carl Quong, Lawrence Berkeley Laboratory.

The initial preparation of the census tract maps for digitizing was accomplished by the Geographic Operations Branch, Data Preparation Division, Bureau of the Census, under the direction of Kurt L.G. Legait, then Branch Chief, and Mary Jo Bell, Chief of the Cartographic Drafting Section.

Marjorie S. Holt prepared the computer files used to control the digitizing operations and attached the geographic references to the digitized files using interactive computer programs developed by Frederick R. Broome.

The digitizing of the census tract outline maps was accomplished through the use of a laser beam, line-following digitizer, owned and operated by i/o Metrics under a contract with Lawrence Berkeley Laboratory. The digitizing was directed by William Roseman, Vice President, i/o Metrics.

The development of the map file editing programs was directed by Carl Quong and Donald Austin of Lawrence Berkeley Laboratory. Harvard Holmes and William Benson developed and wrote the computer programs required to convert the basic digitized files into correct virtual maps of the census tract boundaries. Important contributions to the interactive editing and preparation of the final map files were made by Virginia Franks.

The basic elements of the computer mapping programs and procedures used for the Atlases were independently but concurrently developed by Frederick R. Broome, Bureau of the Census, and Donald Austin, Harvard Holmes, and Peter Wood, Lawrence Berkeley Laboratory. The production of the map plot tapes at Lawrence Berkeley Laboratory was accomplished by Bruce Burkhart using the CARTE mapping package, also developed at Lawrence Berkeley Laboratory. The maps were plotted on 35mm microfilm utilizing the FR 80 Computer Output on Microfilm (COM) unit owned and operated by the National Oceanic and Atmospheric Administration.

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Publication planning was performed by Suzanne Kranz of Lawrence Berkeley Laboratory. The cover and census tract outline maps were prepared under the direction of Ross E. Vaughn, Chief, Cartographic Methods Branch, Geography Division, Bureau of the Census.

Within the Publications Services Division, Bureau of the Census, many individuals made significant contributions in the areas of publication planning and design, editorial review, text composition, and preparation for printing.

GENERAL INTRODUCTION

The atlases in this series provide a graphic presentation of selected census tract statistics as reported in the 1970 Census of Population and Housing, enumerated as of April 1, 1970. Each atlas reports data for a single standard metropolitan statistical area (SMSA). Currently, there are 269 recognized SMSA's including 4 in Puerto Rico, of which 36 have been designated by the Office of Management and Budget based on 1970 census results or a subsequent special census. Atlases are included in this series only for the largest 65 SMSA's that were in existence at the time of the 1970 census. The boundaries that existed in 1970 were used in defining the SMSA's.

This series of reports is one of the several series which present the information compiled from the 1970 census. Information on the full data dissemination program may be obtained from the Chief, Data Access and Use Laboratory, Bureau of the Census, Washington, D.C. 20233.

ORGANIZATION OF THE ATLAS

Each atlas contains 12 maps. Eleven of the maps depict, by tract, the spatial distribution of selected census socioeconomic characteristics, and one map, also at the tract level, shows the interrelationship of two of these characteristics. Each atlas includes a complete set of census tract outline maps of the SMSA to assist the user in identifying the tracts for which data are mapped. The tract outline maps are designed to identify clearly the boundary features that are used to delineate each census tract. Since the atlas maps are designed to display census data spatially, almost all of the small insets found on the tract outline maps have been eliminated and incorporated into larger maps to enable the spatial relationships to be seen more easily. Inset maps are used in the atlas only as necessary to facilitate presentation of data for the small census tracts in the larger SMSA's. Where possible, these insets have been delimited with regard to identifiable physiographic features or prominent political boundaries. Generally, insets are mapped on separate pages. In a few cases, however, an inset may have been located on the same page as the map of the entire SMSA.

To assist the user of the atlas in relating the general characteristics of the individual SMSA to the Nation as a whole, to the States in which the SMSA is located, and to the counties and larger places located within the SMSA, each atlas also includes a table of comparative statistics preceding the first map sheet.

The data contained in the atlas are depicted as percentages, medians, or ratios so that the relative values for the specified characteristic can be compared. Since they show the relative occurrence or the pattern of the data rather than the absolute values of the data for a census tract, caution must be applied in interpreting the maps. For all the derived figures in this report, a light gray color representing "data not available" was used if the base is smaller than the minimum number prescribed for the sample on which the figure is based. The minimum bases are 5 (persons, families, households, or housing units) for figures derived from 100-percent tabulations, 25 for figures based on the 20-percent sample, and 33 for those based on the 15-percent sample. The absolute values for the data shown for any tract can be found in the Census Tract Report (PHC(1) Series) for each SMSA.

1970 CENSUS DATA-COLLECTION AND PROCESSING PROCEDURES

The 1970 census was conducted primarily through self-enumeration. (Self-enumeration was first introduced on a nationwide scale in the 1960 census.)

Several days before Census Day, April 1, 1970, a census questionnaire and an instruction sheet were delivered by postal carriers to every household. In the larger metropolitan areas and some adjacent counties, altogether containing about three-fifths of the population of the United States, the householder was requested to fill out the questionnaire in the privacy of his own home and mail it back on Census Day. Approximately 87 percent of the householders did so. The mailed-back questionnaires were reviewed by census personnel and for those determined to be incomplete or inconsistent, a followup was made to collect the missing information. The bulk of these followups were made by telephone, the rest by personal visit. All households which did not mail back their questionnaires were also called or visited to obtain the census information.

For the remaining two-fifths of the population, the householder was requested to fill out the questionnaire and give it to the enumerator when he called; approximately 80 percent had their questionnaires ready for the enumerator. Questionnaires for the remaining households were completed by personal interview during the enumerator's visit.

Three types of questionnaires were used throughout the country. Eighty percent of the households answered a questionnaire containing a very limited number of population and housing questions. The remainder of the population, split into 15-percent and 5-percent samples, received a more complete and comprehensive questionnaire to answer. A random procedure was used to determine which of the three questionnaires any particular household answered.

The 1970 census questionnaires were specially designed to be processed automatically by the FOSDIC (Film Optical Sensing Device for Input to Computers) microfilm scanner. For most items on the questionnaire, the information supplied by the respondent or obtained by the enumerator was recorded by marking the answers in predesignated positions that could be "read" by FOSDIC from a microfilm copy of the questionnaire and transferred to computer magnetic tape with no intervening manual processing. A number of items, however, such as the description of a person's occupation, required clerical review of a written entry to determine the proper code. These codes were then entered on the census questionnaire and were also read by FOSDIC and added to the computer tape.

These tapes containing all the information except the respondents' names and addresses from the census questionnaires served as input to the Census Bureau's computer editing and tabulation programs.

CENSUS TRACTS

Census tracts are small areas into which large cities and their adjacent areas have been divided for statistical purposes. Tract boundaries are established cooperatively by a local committee and the Bureau of the Census. Tracts are generally designed to be relatively uniform with respect to population characteristics, economic status, and living conditions. The average tract has about 4,000 residents. Tract boundaries are established with the intention of being maintained unchanged over a long period of time so that data comparisons for identical areas may be made from census to census.

The concept of census tracts was originated by the late Dr. Walter Laidlaw in New York City in 1906. He was convinced of the need for data for homogeneous subdivisions of cities as a basis for studying neighborhoods smaller than boroughs or wards. At his request, the Bureau of the Census tabulated census tract data from the 1910 census for New York and 7 other cities with a population of over 500,000. Tract data were again tabulated for the same 8 cities in 1920, and in 1930 this number was increased to 18. In 1940, tract data were tabulated for 90 cities, some with adjacent tracted areas; and, beginning in 1940, housing data were added to the population data in the tract reports. In 1950, reports were published for 64 tracted areas, many of which included statistics for 2 or more large cities. By 1960, the program had expanded to include reports for 180 tracted areas (of which 3 were in Puerto Rico). In the 1970 census, tract statistics were published for 241 areas, 238 in the United States and 3 in the Commonwealth of Puerto Rico.

Much of the credit for the growing interest in tract data belongs to the late Howard Whipple Green of Cleveland. He aroused the interest of research workers in numerous cities in the potential usefulness of tract statistics for the analysis of sociological, marketing, and administrative problems. In his capacity as Chairman of the Committee on Census Enumeration Areas of the American Statistical Association for 25 years, he accepted the responsibility for appointing a Census Tract Key Person in each area where tracts were established, for providing guidance on delineating and maintaining census tracts, and for maintaining a census tract library. These responsibilities were assumed by the Bureau of the Census in 1955. However, the Census Bureau no longer appoints Census Tract Key Persons, which are now selected by the local census tract committees.

The maps included in this atlas identify the boundaries of the tracts as they were defined in 1970. The census tract outline maps, found in the rear of the atlas, identify the location and number of each tract and, where appropriate, the limits of cities, townships, counties, or other subdivisions of the tracted area. Boundaries of the tracted area generally constitute a standard metropolitan statistical area (SMSA). In a few census tract reports, however, an adjoining area outside the SMSA is also included in the tables and on the tract outline maps. These adjacent areas are not shown on the atlas maps. Tracts populated only by crews of vessels have not been mapped.

STANDARD METROPOLITAN STATISTICAL AREAS

Except in the New England States, a standard metropolitan statistical area is a county or group of contiguous counties which contains at least one city of 50,000 inhabitants or more, or "twin cities" with a combined population of at least 50,000. In addition to the county or counties containing such a city or cities, contiguous counties are included in an SMSA if, according to certain criteria, they are socially and economically integrated with the central city. In the New England States, SMSA's consist of towns and cities instead of counties. In recent years, four cities (High Point, N.C., Macon, Ga., Oklahoma City, Okla., and Sioux Falls, S. Dak.) have annexed territory which lies outside the boundaries of the SMSA. The maps for these cities exclude the portions which lie outside the SMSA. Each SMSA must include at least one central city, and the complete title of an SMSA identifies the central city or cities. For a detailed description of the criteria used in defining SMSA's, write the Statistical Policy Division, Office of Management and Budget, Washington, D.C. 20503. Changes in SMSA boundaries or titles made after February 1971 are not recognized in this series of reports.

DEFINITIONS AND EXPLANATIONS OF SUBJECT CHARACTERISTICS

General

The maps contained in this atlas depict spatial distribution of tract data for several broad classes of demographic and housing characteristics. Separate maps are provided for:

1. Population density (population per square mile)
2. Percentage of the total population under 18 years of age
3. Percentage of the total population 65 years of age and older
4. Black population as a percentage of the total population
5. Percentage of all persons 25 years old and over who are high school graduates
6. Median family income
7. Interrelationship of family income and educational attainment
8. Percentage of the total labor force employed in blue collar occupations
9. Median housing value
10. Median contract rent
11. Percentage of all housing units which are owner occupied
12. Percentage of all occupied units constructed from 1960 to March 1970

The class intervals used in the individual maps were derived by subject-matter specialists to reflect meaningful breaks in the data as found in the Nation's metropolitan areas. They remain the same in all the atlases to facilitate comparisons of the maps for one area with those for any other area. Specific values for the data shown in the maps, except the population density map, can be found in the Census Tract Report (PHC(1) Series) for each metropolitan area.

The specific definitions used in collecting and tabulating the data are described below.

Population Characteristics

Population density—Population density is recorded based on the average number of inhabitants per square mile of land area in the tract. Land area includes dry land and land temporarily or partially covered by water, such as marshland, swamps, and river flood plains, streams, sloughs, estuaries, and canals less than one-eighth of a statute mile in width, and lakes, reservoirs, and ponds generally less than 20 acres in area. The land area of each tract was calculated with the aid of an electronic planimeter using the Census Bureau's Metropolitan Map Series (MMS) for tracts shown on the MMS, or using county highway maps in those areas not covered by the MMS. As the boundary of each tract was traced, the equipment automatically converted the surface area into square miles through the use of conversion factors related to the various scales of the source maps. The accuracy of the planimeter was one-thousandth of a square inch. The calculation of the land area of each census tract was performed by the National Planning Data Corporation, Rochester, N.Y. They supplied the population density data shown in map 1 in the form of class intervals. The actual data values for each of these items are not available from the Census Bureau but can be purchased from the National Planning Data Corporation.

Age—The age classification is based on the age of the person in completed years as of April 1, 1970, and was determined from the reply to the census questions on age and month and year of birth.

Race—Data are shown for two racial categories, white and Negro. The category "white" includes persons who indicated their race as white, as well as persons who entered Mexican, Puerto Rican, or a response suggesting Indo-European stock. The category "Negro" includes persons who indicated their race as Negro or black, as well as persons who did not classify themselves in one of the other specific race categories on the questionnaire but who had such entries as Jamaican, Trinidadian, West Indian, Haitian, and Ethiopian.

Household—A household includes all the persons who occupy a group of rooms or a single room which constitutes a housing unit. (See definition of housing unit, below.)

Family—According to 1970 census definitions, a family consists of a household head and one or more other persons living in the same household who are related to the head by blood, marriage, or adoption; all persons in a household who are related to the head are regarded as members of his (her) family. Not all households contain families, because a household may be composed of a group of unrelated persons or of one person living alone.

High school graduates—The data on years of school completed were derived from the answers to the two questions: (a) "What is the highest grade (or year) of regular school he has ever attended?" and (b) "Did he finish the highest grade (or year) he attended?" Persons whose highest grade of attendance was in a foreign school system or in an ungraded school whose highest level of schooling was measured by "readers," or whose training was received through a tutor, were instructed to report the approximate equivalent grade in the regular U.S. school system. A person was reported as not having completed a given grade if he dropped out or failed to pass the last grade attended.

Worker—The data on this subject relate to employed persons 16 years old and over and refer to the job held during the reference week. (See below.) For persons employed at two or more jobs, the data refer to the job at which the person worked the greatest number of hours. The occupational classification "blue collar" is based on the detailed classification systems developed for the 1970 census. (See **1970 Census of Population, Classified Index of Industries and Occupations**, U.S. Government Printing Office, Washington, D.C., 1971.)

Labor force—The data on labor force include all persons in the civilian labor force plus members of the Armed Forces (persons on active duty with the U.S. Army, Air Force, Navy, Marine Corps, or Coast Guard). All persons 16 years old and over are classified as members of the labor force except for students, housewives, retired workers, seasonal workers enumerated in an "off" season who were not looking for work, inmates of institutions, disabled persons, and persons doing only incidental unpaid family work (less than 15 hours during the reference week).

Reference week—The data on employment status and place of work relate to the calendar week preceding the date on which the respondents completed their questionnaires or were interviewed by enumerators. This week is not the same for all respondents because not all persons were enumerated during the same week.

Income in 1969—Information on money income received in calendar year 1969 was requested from persons 14 years old and over. "Total income" is the algebraic sum of the amounts reported separately for wage and salary income, nonfarm net self-employment income, Social Security or railroad retirement income, public assistance or welfare income, and all other income. The figures represent the amount of income regularly received before deductions for personal income taxes, Social Security, bond purchases, union dues, medicare deductions, etc.

Receipts from the following sources were not included as income: Money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income "in kind," such as food produced and consumed in the home or free living quarters; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump-sum receipts.

Although the income statistics cover calendar year 1969, the characteristics of persons and the composition of families refer to the time of enumeration (April 1, 1970). For most families, however, the income reported was received by persons who were members of the family throughout 1969.

Housing Characteristics

Housing units—A housing unit is a house, an apartment, a group of rooms, or a single room, occupied or intended for occupancy as separate living quarters. Living quarters may also be in structures intended for nonresidential use (for example, the rooms in a warehouse where a watchman lives), as well as in tents, caves, old railroad cars, etc. Separate living quarters are those in which the occupants do not live and eat with any other persons in the structure and which quarters have either (1) direct access from the outside of the building or through a common hall or (2) complete kitchen facilities for the exclusive use of the occupants. The occupants may be a single family, one person living alone, two or more families living together, or a group of related or nonrelated persons. Both occupied and vacant housing units are included in the housing inventory, except that mobile homes, trailers, tents, etc., are included only if they are occupied.

Occupied housing units—A housing unit is classified as occupied if a person or group of persons is living in it at the time of enumeration or if the occupants are only temporarily absent (for example, on vacation). However, if the persons staying in the unit have their usual place of residence elsewhere, the unit is classified as vacant.

Tenure—A housing unit is "owner occupied" if the owner or co-owner lives in the unit, even if it is mortgaged or not fully paid for. A cooperative or condominium unit is "owner occupied" if the owner or co-owner lives in it. All other occupied units are classified as "renter occupied," including units rented for cash rent and those occupied without payment of cash rent.

Year structure built—"Year structure built" refers to the date when the building was first constructed, not when it was remodeled, added to, or converted.

Value—"Value" is the respondent's estimate of how much the property (house and lot) would sell for if it were for sale. The value data shown on the maps are limited to owner-occupied one-family houses on less than 10 acres, without a commercial establishment or medical office on the property. Owner-occupied cooperatives, condominiums, mobile homes, and trailers are excluded from the value tabulations.

Contract rent—Contract rent is the monthly rent agreed to, or contracted for, whether or not the furnishings, utilities, or services are included. The contract rent data shown on the maps exclude one-family houses on 10 acres or more. Renter units occupied without payment of cash rent are shown as "no cash rent" in the rent tabulations and are grouped in the lowest class interval on the maps.

SOURCES OF ERROR

Data error—Human and mechanical errors occur in any mass statistical operation such as a decennial census. Errors during the data-collection phase can include failure to obtain required information from respondents, obtaining incorrect or inconsistent information, and recording information incorrectly. Errors can also occur during the field review of the enumerator's work, the clerical handling of the questionnaires, and the various stages of the electronic processing of the material. Continuing control and check measures were utilized throughout the census operation to assure acceptable levels of quality.

Tract boundary error—Various errors, most of which are minor, are known to exist in some of the tract boundary delineations. The preparation of the digitized census tract boundary files for use in the atlases utilized a sophisticated interactive computer editing procedure which allowed many of the discrepancies found on the original census tract outline maps to be corrected prior to the preparation of the atlas maps. In a few areas, the exact tract boundary lines have been generalized on the atlas maps because of the map scale factor.

HOW THE MAPS WERE PRODUCED

Background

Early in the planning of the publications for the 1970 Census of Population and Housing, considerable thought was given to the possibility of creating an urban atlas, that is, the preparation of maps showing the spatial patterns of selected demographic characteristics within the major metropolitan areas of the Nation. However, as of 1970, the state of the art of computer cartography had not advanced sufficiently to enable the maps to be prepared using automated techniques. (Preparation of choropleth maps of the major metropolitan areas by the standard manual cartographic techniques had previously been ruled out as being too expensive.) Consequently, the idea of producing a series of urban atlases was dropped at that time.

Fortunately, computer graphics technology progressed far more rapidly than many of its most ardent proponents had hoped was possible. In addition, early in 1972, the Geography Division of the Bureau of the Census acquired an interactive computer graphics system which enabled an entirely new approach to computer mapping using micrographics to be developed. This new computer mapping system could produce maps of high quality, at low costs, and with minimal clerical effort. The key to the new approach was the use of a COM (Computer Output to Microfilm) unit capable of producing color separation negatives of publication quality. Thus, definitive plans for the preparation of a series of urban atlases were developed. During the course of this work it was discovered that other Federal Agencies had similar mapping interests, and in March of 1973, the Census Bureau's project was merged with two other projects to produce a national set of digitized census tract boundary files. The other agencies who participated in this work were the Manpower Administration of the Department of Labor and the Department of Housing and Urban Development.

Actual production of the urban atlases can be divided into three major sets of activities. They are (1) the digitizing of the census tract maps, (2) the editing of the digitized files, and (3) the creation of the microfilm negatives. Each of these phases required the development of new methodology advancing the "state of the art" before progress could be made. This would not have been possible without the unique resources and expertise of the Lawrence Berkeley Laboratory (LBL) of the University of California at Berkeley. They designed and put into operation a total system which consisted of three major components: A system for digitizing the census tract maps; a system for editing and coding the digitized map files and creating a geographic data base; and a system for correlating statistical data with geographical coordinates for the production of microfilm negatives.

The Digitizing System

The digitized map files created as a data base for this project include the boundaries of approximately 35,000 census tracts in 241 SMSA's in the Nation and Puerto Rico. An automated system was developed by LBL in collaboration with the Geography Division of the Bureau of the Census and the I/O Metrics Corporation of Sunnyvale, Calif. The basis of the system is the I/O Metrics Corporation's SWEEPNIK device, built by Laser-Scan, Ltd., of Cambridge, England.

The heart of the digitizing hardware is a rapidly spinning prism which displaces a precisely focused light beam from a gas laser into a small circular orbit. The beam is then deflected by mirrors to any point on a 160mm by 110mm film plane, where a photomultiplier measures the amount of light transmitted through the film. A pair of *interferometers precisely measure the x and y positions of the mirrors*, giving the beam position on the film plane to an accuracy of 1 micron (.001mm). An interactive, minicomputer system controls the entire apparatus.

In operation, rolls of 105mm positive film, containing clean versions of the census tract outline maps, are automatically positioned in the film plane. A "driver" tape (created from the MEDList tapes), containing fiducial information for each map and inset and also the numeric codes and centroids for each census tract, is loaded. The computer reads the tract centroid coordinates and positions the beam within the boundaries of the tract. The beam is moved until a boundary line is detected; the computer reads the angles of the edges of the line, computes the center of the line, and then moves the beam one step (typically 40 microns) clockwise along the direction of the line. When a line crossing is detected, the computer always chooses the line on the right, thus performing a clockwise trace of each tract boundary. Each record contains an identifier code and the coordinates of points associated with the tract boundary. The first record contains the fiducial points in both latitude, longitude, and digitizer coordinates, allowing for the transformation of the boundary points to absolute earth grid coordinates.

The operation is under the control of an operator seated at a console consisting of a TV monitor, a large Fresnel screen showing the film image, a track ball for manually positioning the beam, a Teletype terminal and a storage tube display. This allows operator interaction for ambiguous spots on the film where the line-following algorithm is unable to decipher the boundary. Also, split tracts and zero population tracts for which no centroids are available on the MEDList tapes can be referenced on-line by the operator.

The MAPEDIT System

LBL's MAPEDIT system consists of four programs which process the digitizer output and create the final geographic data base. The first program is responsible for converting the basic digitized file to formats required for other programs, for noise removal, for line smoothing, for inset correction, and for boundary matching. Most of the major problems handled by this program were due to the original cartography of the census tract outline maps. For instance, insets were originally drawn, and thus digitized, at a much larger scale than the base maps, and this finer resolution must be matched with more general base maps when the coordinates are converted to the fixed set of earth grid coordinates. This was implemented by providing a four-point transformation which allows for translations, rotations, scaling on each axis, and skewing, and a distorting transformation which allows for a shape change. A boundary-matching algorithm compares the boundaries of adjacent tracts which are mismatched and moves or adds points to attempt an exact fit.

A second program produces a reproduction of the map on 105mm microfiche with a latitude-longitude grid overlay. The microfiche is examined with viewers at a scale of approximately 1,000 meters to the inch, equivalent to a map 10 feet wide. This review is necessary to correctly determine the proper points needed for the four-point transformation.

A third program allows interactive graphics editing of the final file to remove any unresolved problems. It was developed from the graphics modeling system, PICASSO, developed at LBL. This program uses the CDC 250 VISTA system equipped with CRT consoles, light pens, function keyboards, and Teletype terminals, interfaced to a multiprogrammed CDC 6600. Tract boundaries reside on a random-access disk file and are read into memory and displayed on a refresh CRT at the editor's request. Points may be moved, added, or deleted by the editor using the light pen to select the appropriate command from a command list and pointing to the points to be altered on the CRT so as to agree with the tract boundaries as shown on the original map. Tracts or line segments which were missed may be drawn in by hand, and identification codes may be corrected. The CRT picture can be enlarged from 1 to 64 diameters by the editor for ease of editing, and the picture can be panned easily to facilitate stepping around the boundary. This procedure was used to edit every census tract to assure accuracy and completeness.

The fourth program in the system inserts a set of seven geocodes (State, SMSA, urban area, county, place, MCD, and tract) from the MEDList tapes and saves two copies of the resulting file—one on magnetic tape and one on an LBL photodigital chip storage device.

The Computer Mapping System

Late in 1972 the Geography Division of the Census Bureau and Lawrence Berkeley Laboratory independently developed a completely new approach to automated cartography. This approach involved the outputting of the map images from a computer file directly onto 35mm microfilm using a high precision COM (Computer Output to Microfilm) unit. This new technology provided the basis for the production of high quality maps in the **1969 Census of Agriculture Graphics Supplement** and the **Manpower Indicator Atlas**, which were independently produced by the two agencies in 1973.

The input to the mapping system consists of two components: a digitized file of tract boundary lines and a computer tape containing the tract data to be mapped. These two elements are processed through a series of computer programs to produce a strip of microfilm containing six images for each map. These microfilm images—which are, in fact, miniature color separation negatives—are enlarged and screened to produce the press negatives for the printer.

The graphics display program used to create the plot tapes, CARTE, matches coded statistical data with the coded map files and produces a set of microfilm images according to a set of directives describing the desired map layout. This mapping package, developed at LBL, is able to scale the final map image, remove insets, and add titles and other descriptive information. The final output is a computer tape formatted for direct plotting on a COM unit.

The COM used is an FR-80 manufactured by Information International Incorporated and operated by the National Oceanic and Atmospheric Administration. It has a resolution of 80 lines per millimeter. The image is rapidly created on a 3-inch square in the center of a 5-inch CRT. Across the 3 inches in each dimension there are 16,384 addressable point locations. The maps are drawn by an electron beam which is moved in successive vectors under control of the mapping program, which "instructs" the FR-80 how to display the tract boundaries and which boundaries to display. As a picture is "drawn" (displayed) on the CRT it exposes a frame of microfilm. Each frame of film includes only the tracts that fall in a particular class interval and are thus to be shown as a separate color on the printed maps. (Each class interval is printed in a separate color.) The images are, in fact, clear "windows" surrounded by an unexposed or black negative.

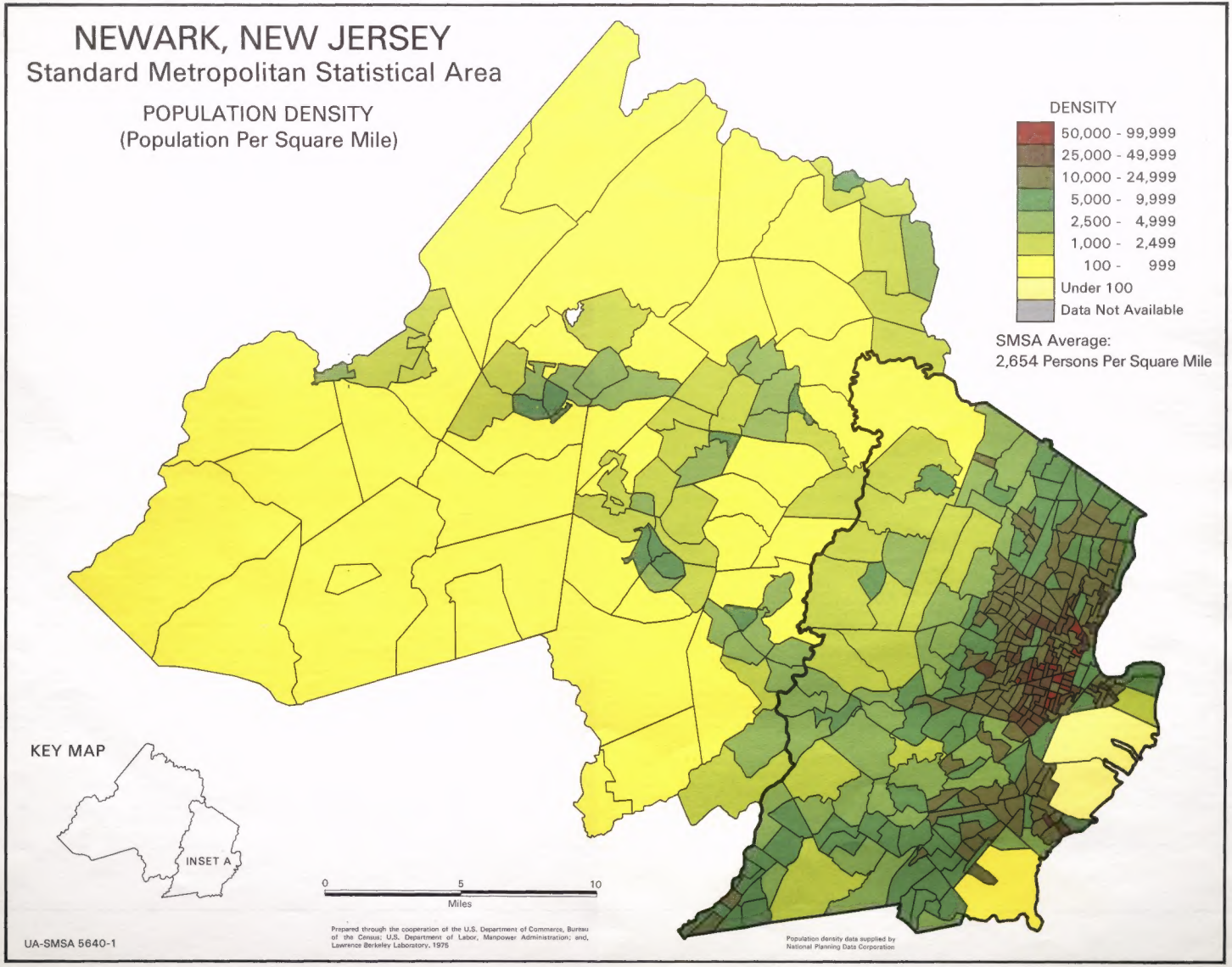
Seven frames of 35mm film, six window negatives (one for each class interval) plus one additional frame containing the outline of the tract boundaries, are produced on the COM unit for each map. Each frame of microfilm also contains precise registration marks to assure proper alignment of the separate frames during subsequent processing. Each negative is enlarged to the exact publication size. High-speed negative-to-negative film is used during the enlargement step to avoid the usual necessity of an intermediate enlarged positive. The titles, legend, and credits are transferred manually to the enlarged tract boundary outline image. The placement of this information varies SMSA by SMSA depending upon the physical shape of the area. The enlarged negatives are then screened as necessary to produce the final composite negatives for color printing of each map.

These techniques resulted in the production of traditional color separation map negatives of the same high level of quality as found in traditional cartography at a fraction of the cost of manual techniques.

Table 1

SUMMARY OF URBAN ATLAS CHARACTERISTICS:
United States, States, SMSA, Component
Counties, and Places of 25,000 or Larger

Map Number and Characteristics	United States	N.J.	Total SMSA	Essex County	Morris County	Union County	Belleville	Bloomfield	East Orange	Elizabeth	Irvington	Linden	Montclair	Newark	Nutley	Orange	Plainfield	Rahway	Westfield	West Orange
1: POPULATION DENSITY (Population Per Square Mile)	57	953	2,654	7,173	819	5,273	11,067	9,635	19,352	9,629	20,601	3,764	7,104	16,252	9,386	14,803	7,810	7,279	5,352	3,643
2: PERCENTAGE OF THE TOTAL POPULATION UNDER 18 YEARS OF AGE	34.3	33.4	32.9	32.4	36.6	31.3	28.7	27.5	26.4	28.9	21.9	29.2	28.5	37.4	29.9	28.0	33.4	31.9	36.5	30.2
3: PERCENTAGE OF THE TOTAL POPULATION 65 YEARS OF AGE AND OLDER	9.9	9.8	9.9	10.7	7.4	10.1	9.5	12.4	14.3	11.9	18.0	8.8	15.0	8.0	10.5	12.7	11.4	8.9	9.0	11.4
4: BLACK POPULATION AS A PERCENTAGE OF THE TOTAL POPULATION	11.1	10.7	18.8	30.0	2.2	11.2	2.5	1.8	53.1	15.5	3.9	12.8	27.1	54.2	1.6	35.7	40.0	13.4	4.8	1.1
5: PERCENTAGE OF ALL PERSONS 25 YEARS OLD AND OVER WHO ARE HIGH SCHOOL GRADUATES	52.3	52.5	55.1	49.3	67.0	57.0	47.0	53.3	52.2	43.7	38.3	44.4	68.2	33.2	56.9	45.4	54.0	52.9	78.7	64.8
6: MEDIAN FAMILY INCOME, DOLLARS	9,586	11,403	11,845	10,682	13,420	12,590	11,304	11,733	10,111	10,277	10,257	11,368	14,498	7,734	12,710	9,477	10,951	11,885	17,493	13,878
8: PERCENTAGE OF THE TOTAL LABOR FORCE EMPLOYED IN BLUE COLLAR OCCUPATIONS	35.9	38.0	34.1	35.9	28.6	35.0	37.7	33.0	33.3	45.1	39.5	47.0	19.2	49.9	31.5	32.6	36.4	42.4	17.7	21.9
9: MEDIAN HOUSING VALUE, DOLLARS	17,130	23,504	28,248	27,537	29,244	28,089	22,779	24,036	19,761	20,530	19,281	24,639	33,187	17,231	26,459	19,138	22,568	23,109	36,862	29,851
10: MEDIAN CONTRACT RENT, DOLLARS	89	111	118	113	138	122	125	123	131	110	117	116	125	104	131	118	123	116	142	135
11: PERCENTAGE OF ALL HOUSING UNITS WHICH ARE OWNER OCCUPIED	62.9	60.9	53.4	40.8	73.0	63.3	53.7	54.1	24.7	32.7	31.9	64.5	52.8	20.5	67.2	25.9	51.9	67.5	81.3	69.3
12: PERCENTAGE OF ALL OCCUPIED UNITS CONSTRUCTED FROM 1960 TO MARCH 1970	25.0	21.9	17.3	12.0	33.4	16.3	13.8	8.9	10.7	17.6	13.2	15.4	7.4	8.7	14.1	13.6	12.3	14.9	10.3	16.4


NEWARK, NEW JERSEY
Standard Metropolitan Statistical Area
POPULATION DENSITY
(Population Per Square Mile)
DENSITY
50,000 - 99,999
25,000 - 49,999
10,000 - 24,999
5,000 - 9,999
2,500 - 4,999
1,000 - 2,499
100 - 999
Under 100
Data Not Available
SMSA Average:
2,654 Persons Per Square Mile
KEY MAP
INSET A
0
5
10
Miles
Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1975
Population density data supplied by National Planning Data Corporation
UA-SMSA 5640-1

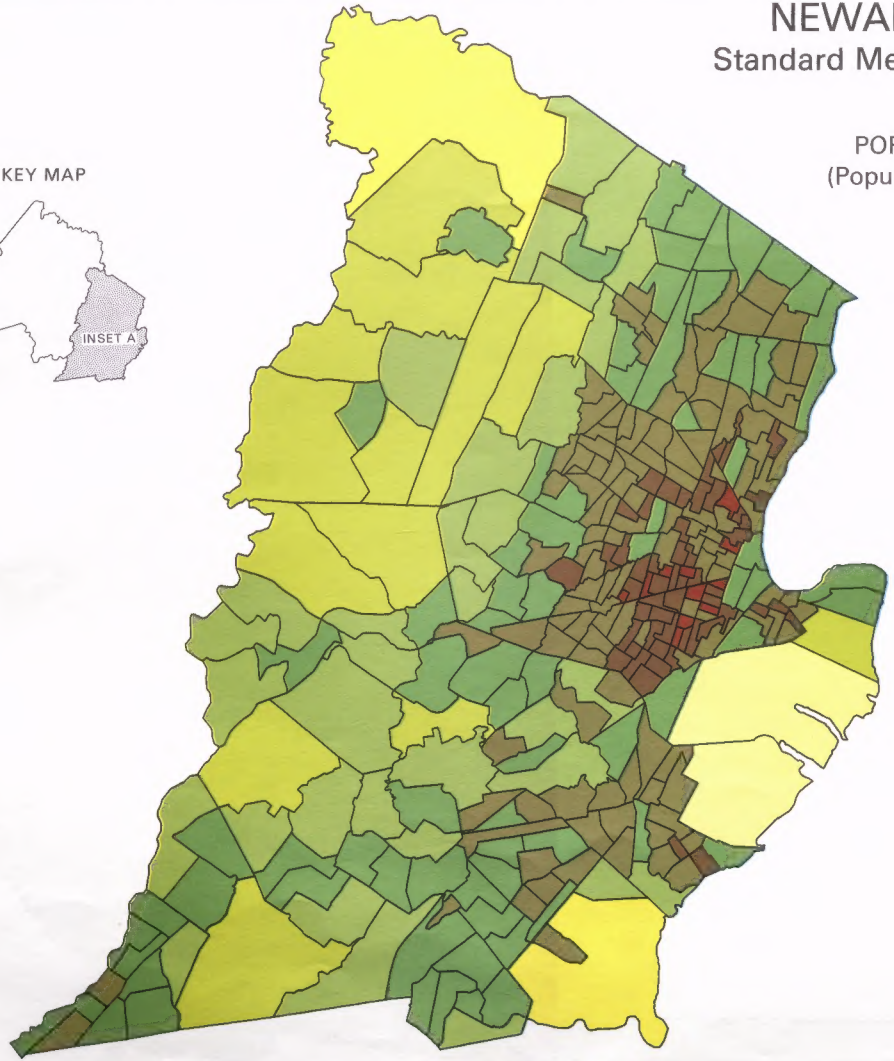
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

POPULATION DENSITY
(Population Per Square Mile)

KEY MAP



DENSITY

	50,000 - 99,999
	25,000 - 49,999
	10,000 - 24,999
	5,000 - 9,999
	2,500 - 4,999
	1,000 - 2,499
	100 - 999
	Under 100
	Data Not Available

SMSA Average:
2,654 Persons Per Square Mile

0 1 2 3
Miles

UA-SMSA 5640-1-A

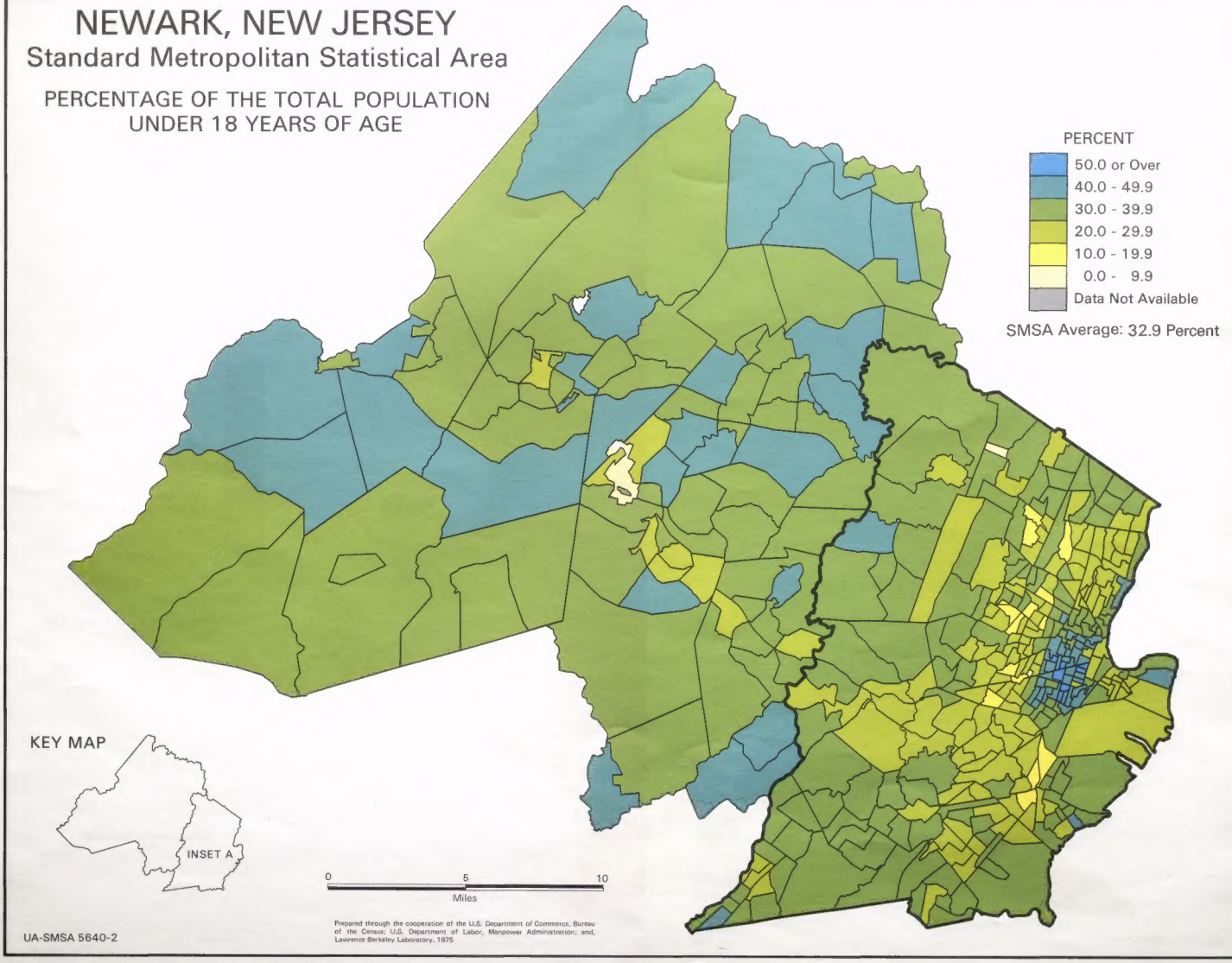
Population density data supplied by National Planning Data Corporation

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF THE TOTAL POPULATION
UNDER 18 YEARS OF AGE



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1975

UA-SMSA 5640-2

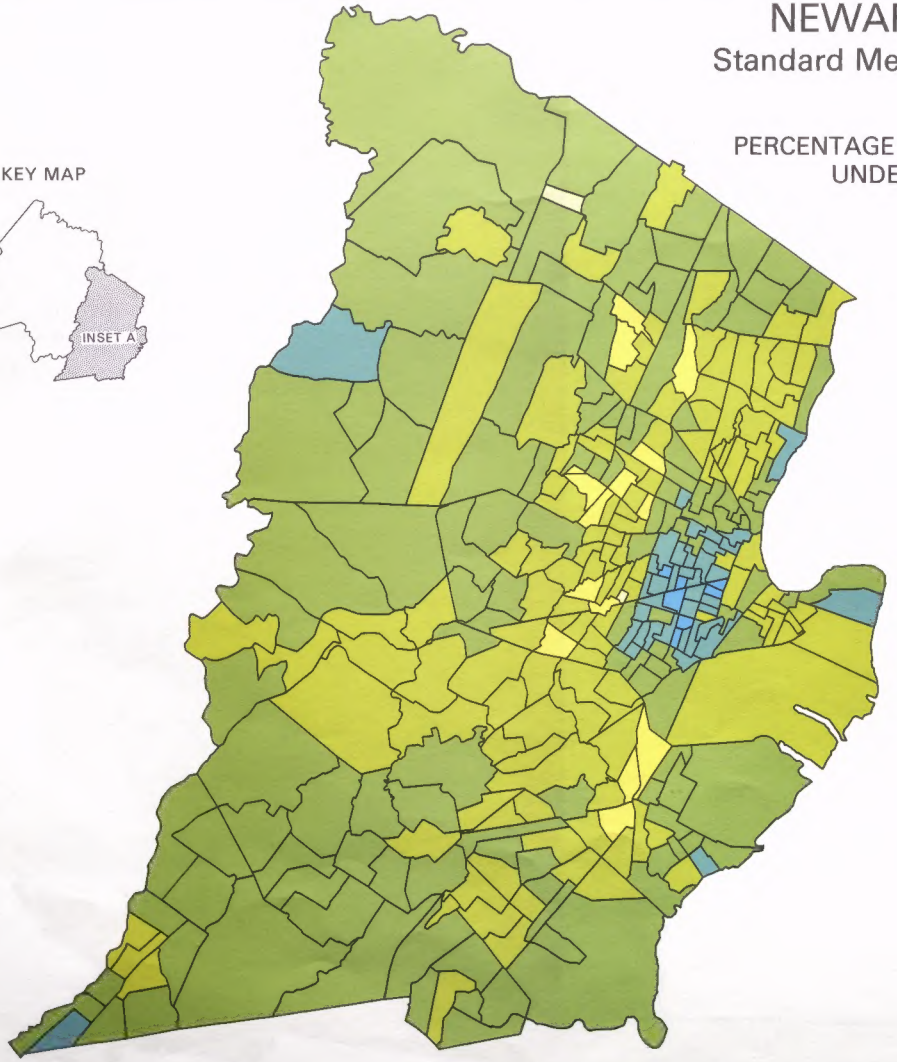
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

PERCENTAGE OF THE TOTAL POPULATION UNDER 18 YEARS OF AGE

KEY MAP



PERCENT

- 50.0 or Over
- 40.0 - 49.9
- 30.0 - 39.9
- 20.0 - 29.9
- 10.0 - 19.9
- 0.0 - 9.9
- Data Not Available

SMSA Average: 32.9 Percent

0 1 2 3

Miles

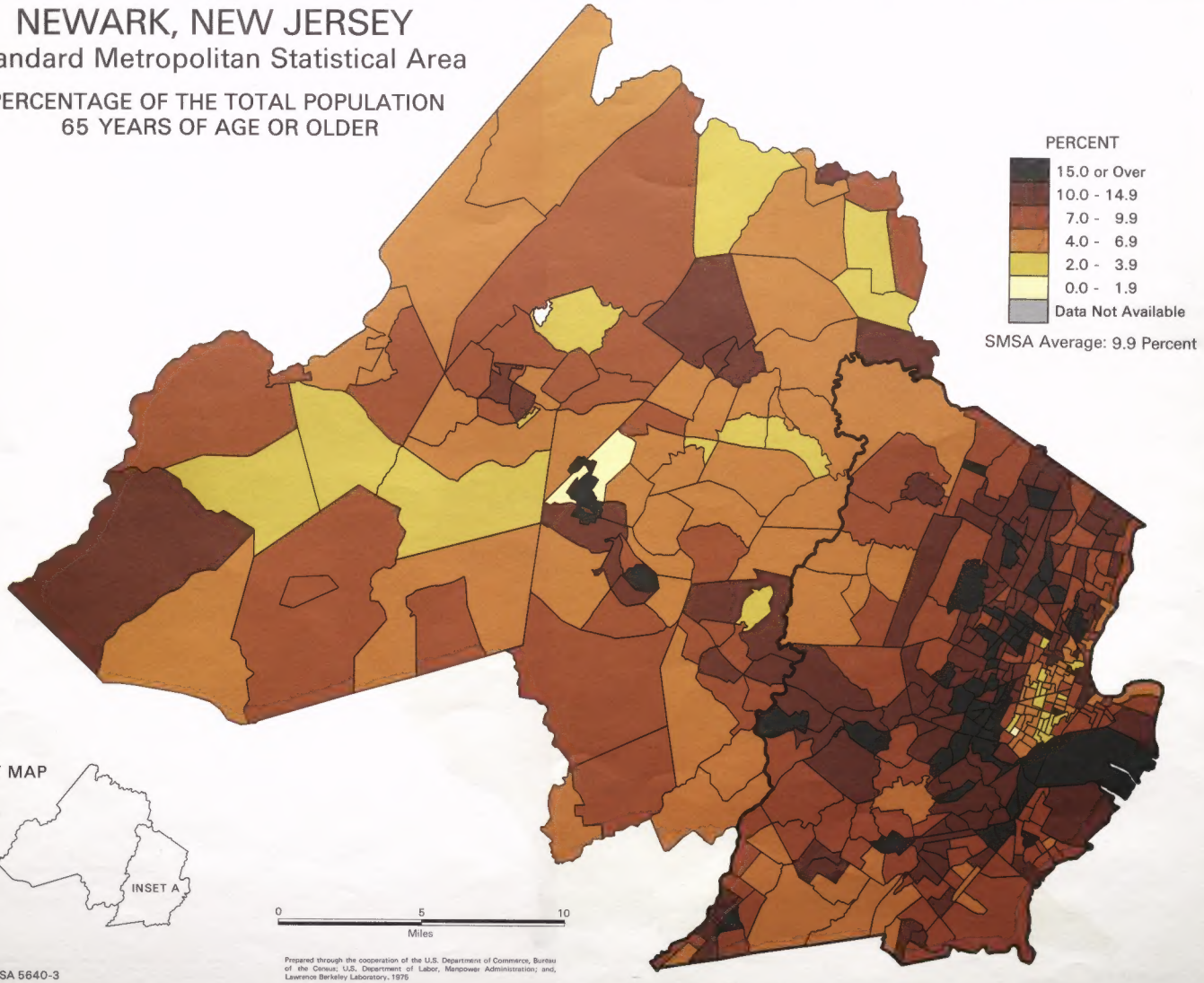
UA-SMSA 5640-2-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF THE TOTAL POPULATION 65 YEARS OF AGE OR OLDER



UA-SMSA 5640-3

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1976

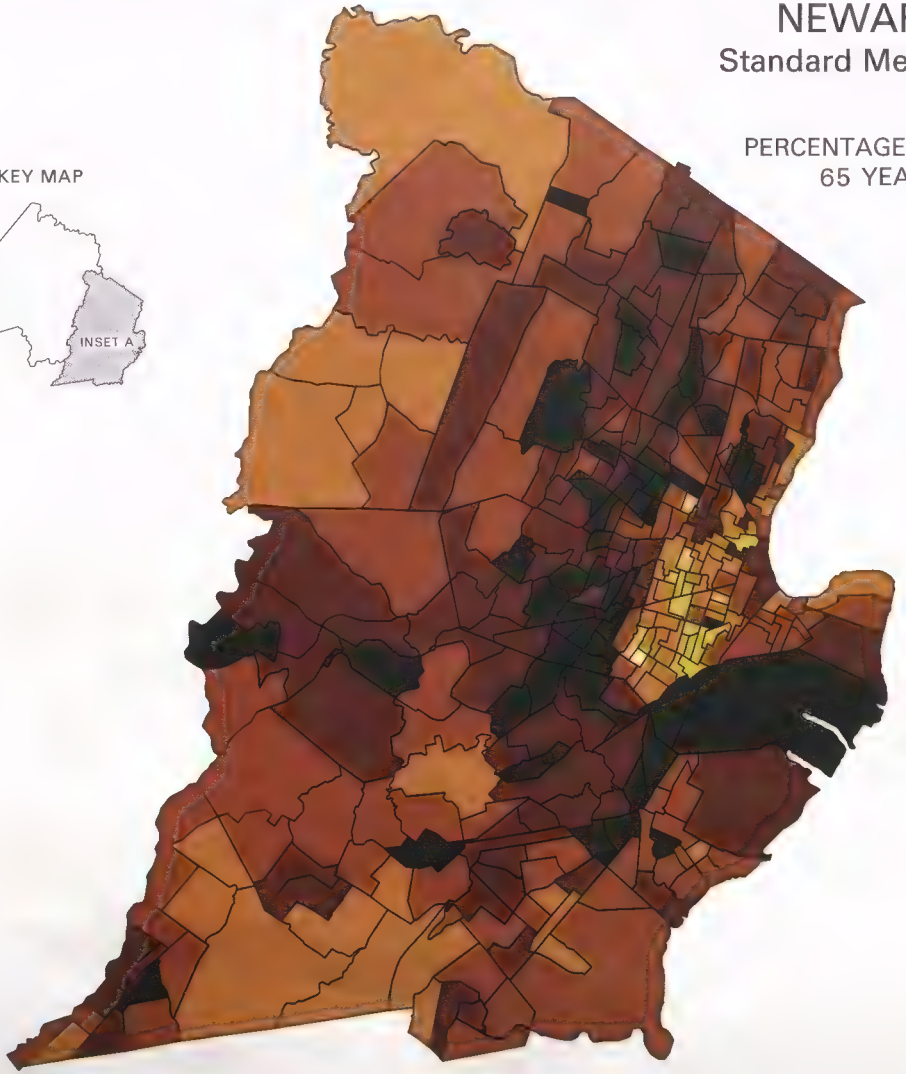
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

PERCENTAGE OF THE TOTAL POPULATION
65 YEARS OF AGE OR OLDER

KEY MAP



PERCENT

- 15.0 or Over
- 10.0 - 14.9
- 7.0 - 9.9
- 4.0 - 6.9
- 2.0 - 3.9
- 0.0 - 1.9
- Data Not Available

SMSA Average: 9.9 Percent

0 1 2 3
Miles

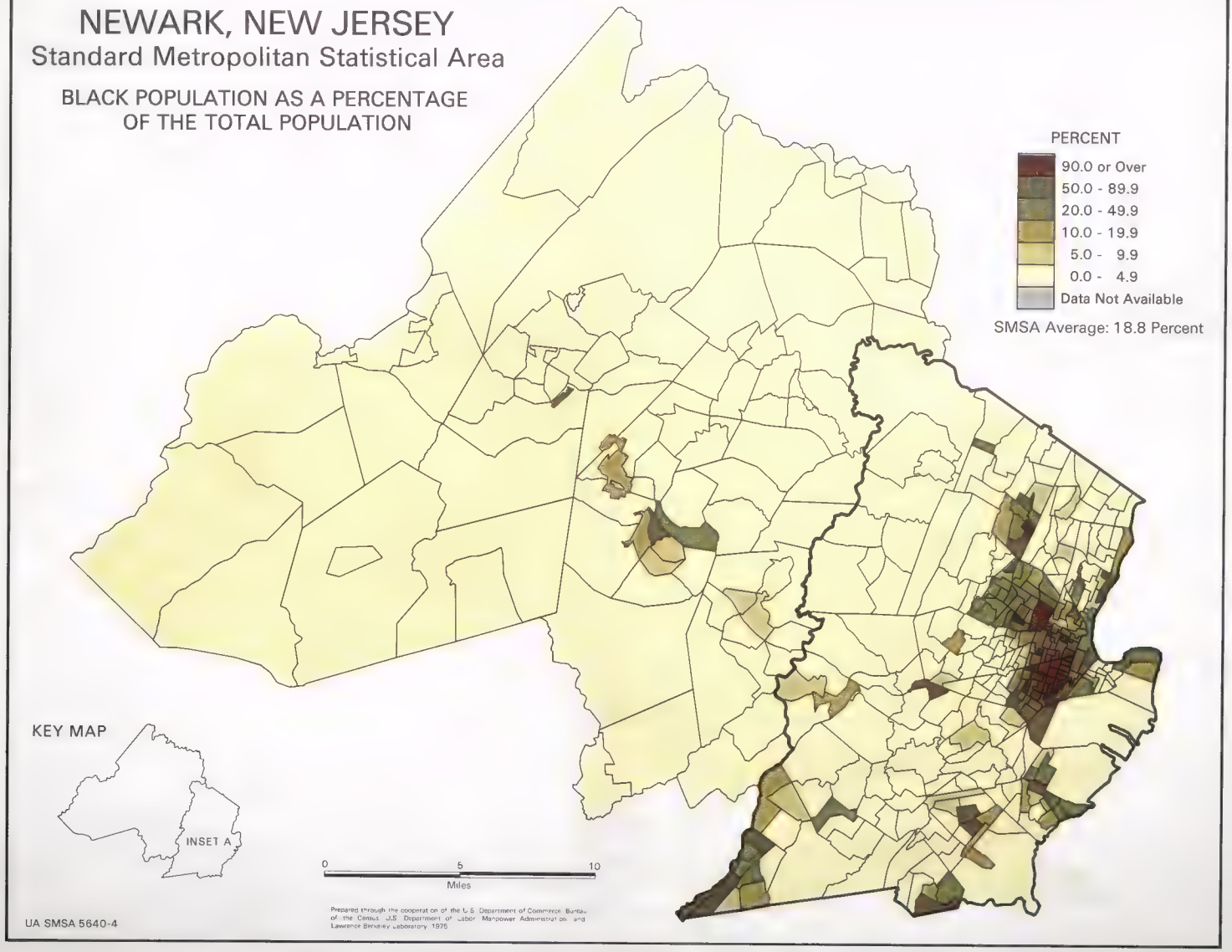
UA-SMSA 5640-3-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and, Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

BLACK POPULATION AS A PERCENTAGE OF THE TOTAL POPULATION



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

UA SMSA 5640-4

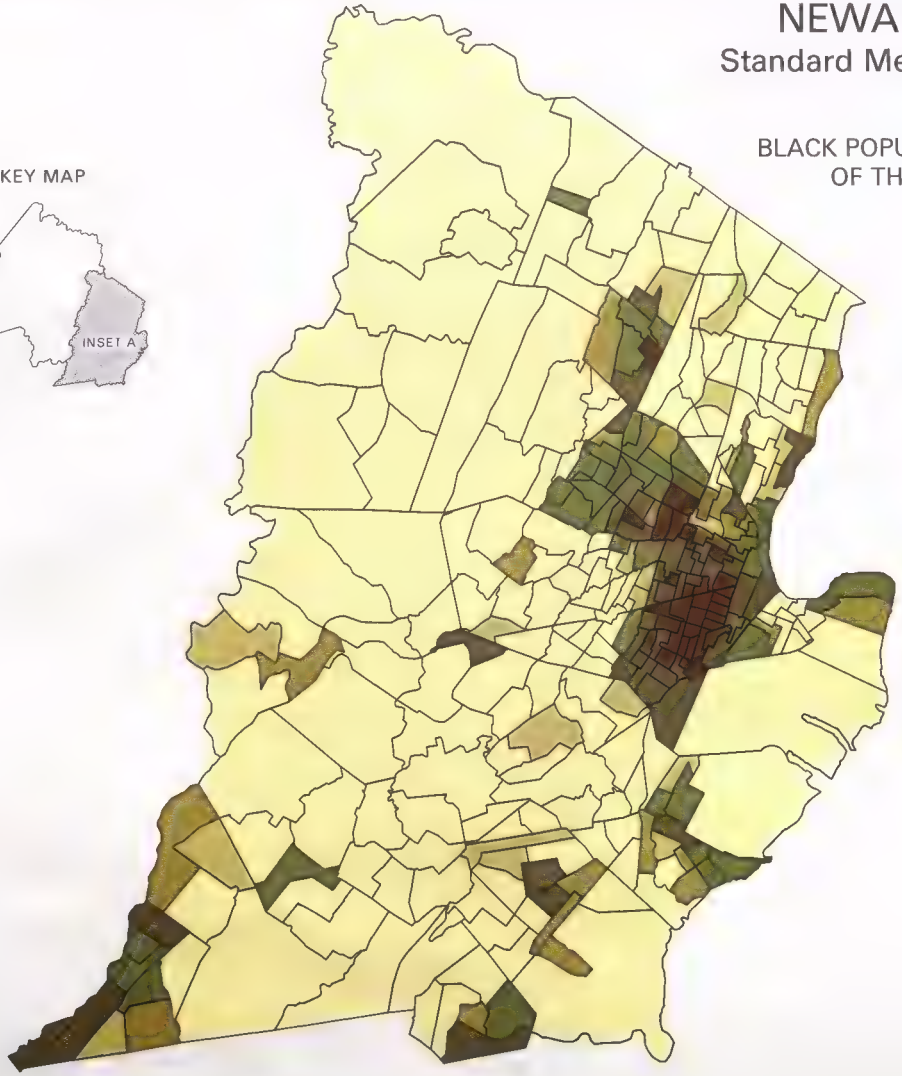
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

BLACK POPULATION AS A PERCENTAGE OF THE TOTAL POPULATION

KEY MAP



PERCENT

- 90.0 or Over
- 50.0 - 89.9
- 20.0 - 49.9
- 10.0 - 19.9
- 5.0 - 9.9
- 0.0 - 4.9
- Data Not Available

SMSA Average: 18.8 Percent

0 1 2 3
Miles

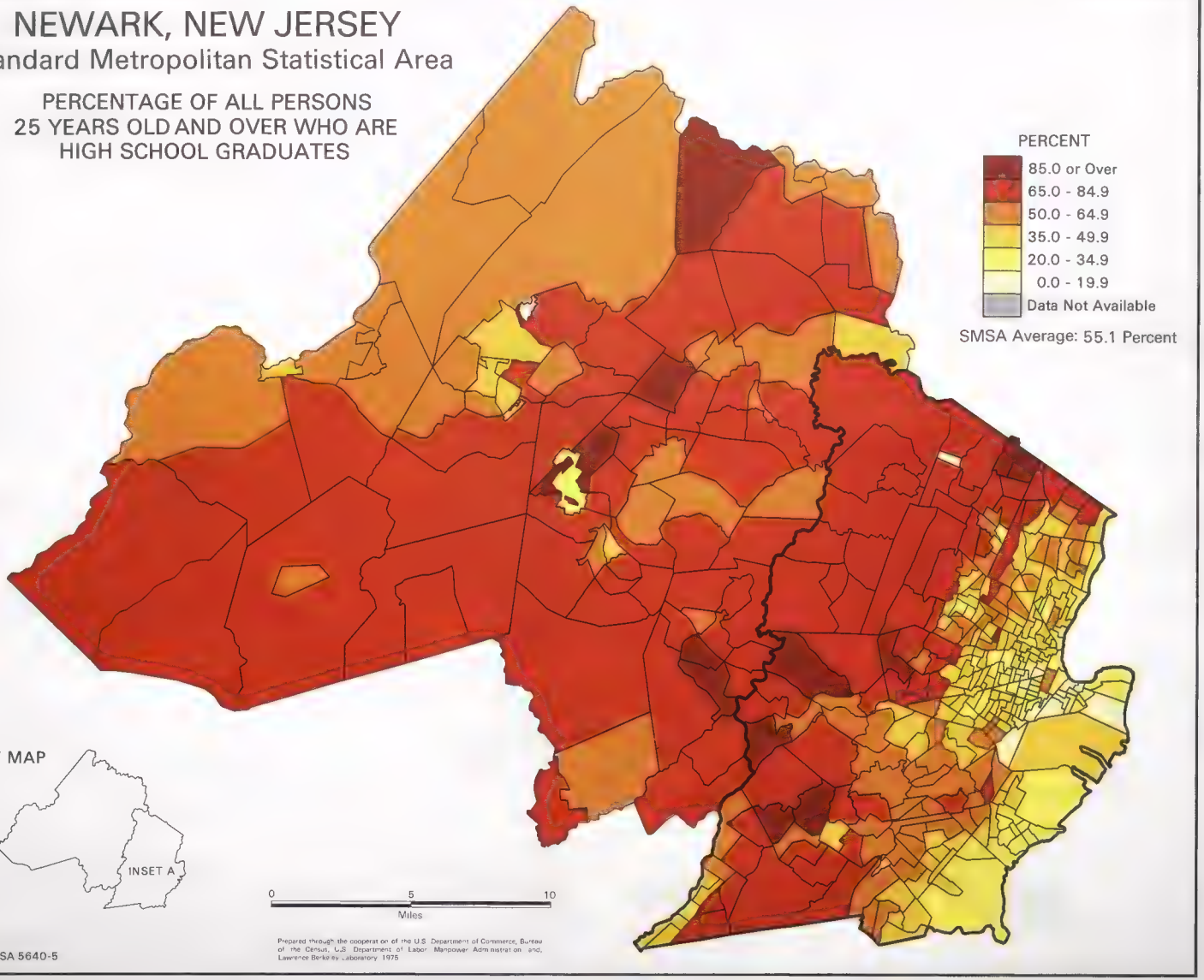
UA-SMSA 5640 4-A

Prepared through the cooperation of the U.S. Department of Commerce Bureau of the Census, U.S. Department of Labor, Manpower Administration and Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF ALL PERSONS
25 YEARS OLD AND OVER WHO ARE
HIGH SCHOOL GRADUATES



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

UA SMSA 5640-5

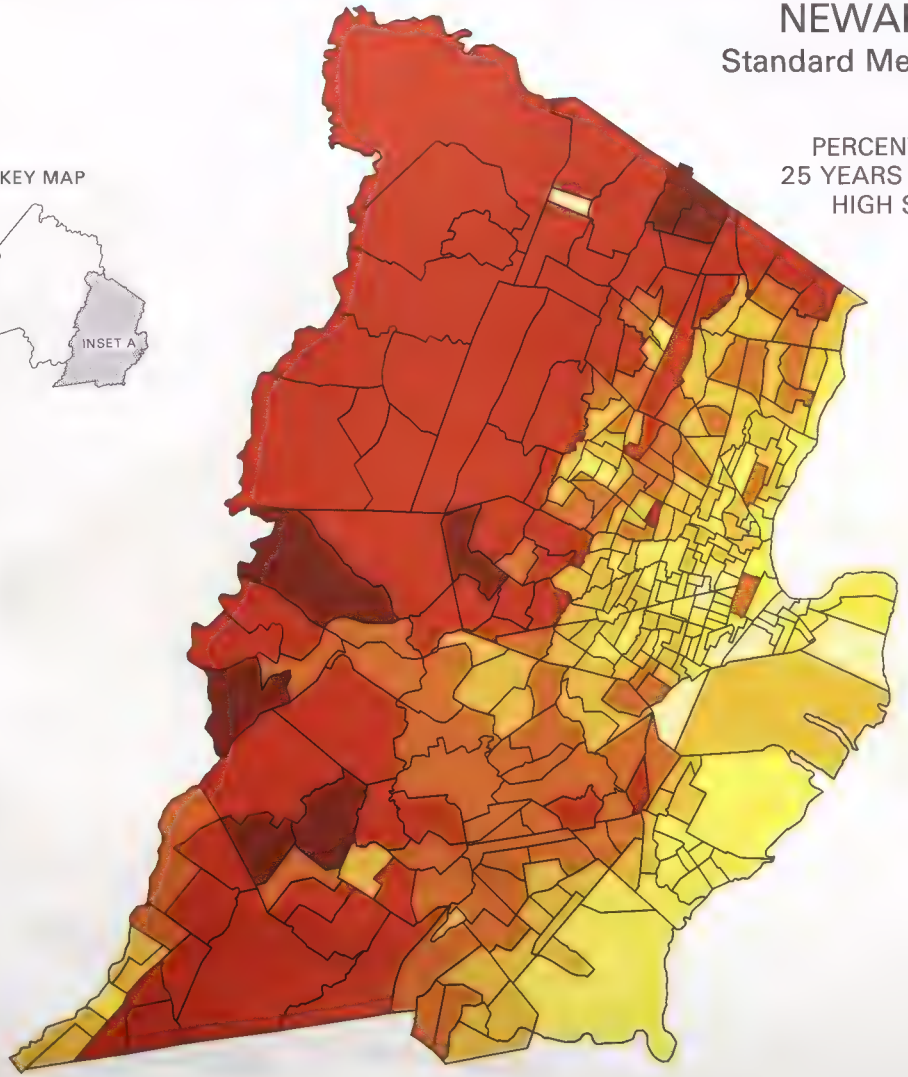
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

PERCENTAGE OF ALL PERSONS
25 YEARS OLD AND OVER WHO ARE
HIGH SCHOOL GRADUATES

KEY MAP



PERCENT

- 85.0 or Over
- 65.0 - 84.9
- 50.0 - 64.9
- 35.0 - 49.9
- 20.0 - 34.9
- 0.0 - 19.9
- Data Not Available

SMSA Average: 55.1 Percent

0 1 2 3
Miles

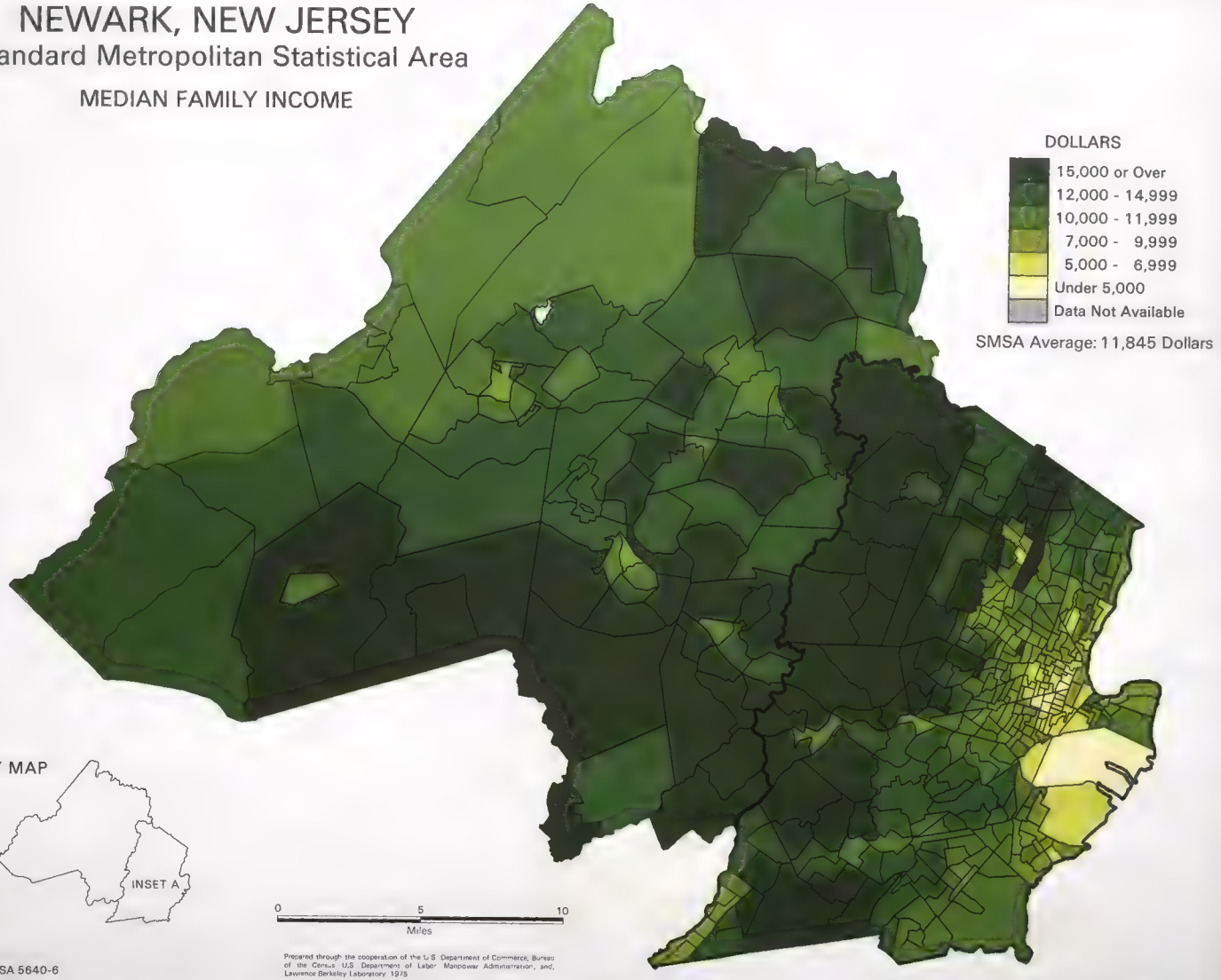
UA-SMSA 5640-5-A

Prepared through the cooperation of the U.S. Department of Commerce Bureau of the Census, U.S. Department of Labor, Manpower Administration and, Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

MEDIAN FAMILY INCOME



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and, Lawrence Berkeley Laboratory, 1975

UA-SMSA 5640-6

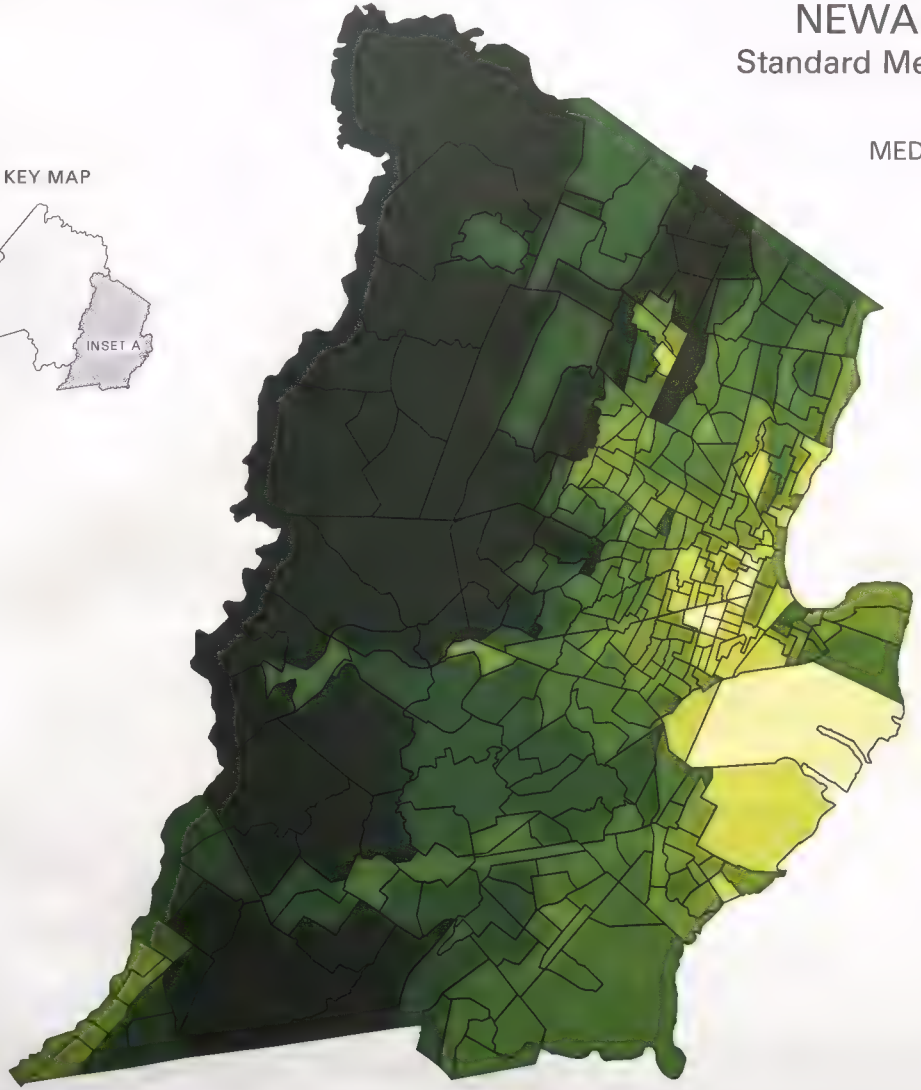
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

MEDIAN FAMILY INCOME

KEY MAP



DOLLARS

- 15,000 or Over
- 12,000 - 14,999
- 10,000 - 11,999
- 7,000 - 9,999
- 5,000 - 6,999
- Under 5,000
- Data Not Available

SMSA Average: 11,845 Dollars

0 1 2 3

Miles

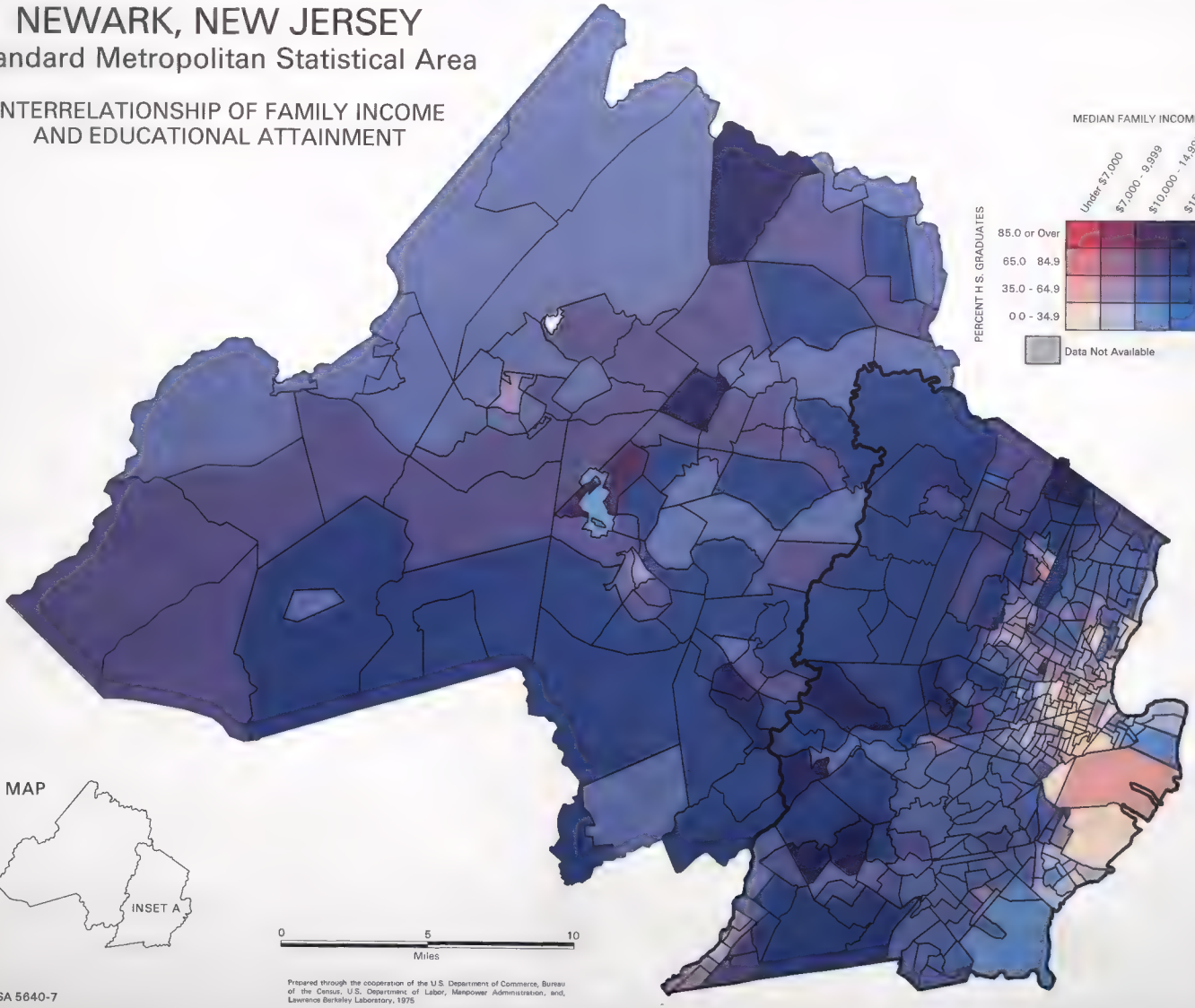
UA SMSA 5640-6-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INTERRELATIONSHIP OF FAMILY INCOME AND EDUCATIONAL ATTAINMENT



UA-SMSA 5640-7

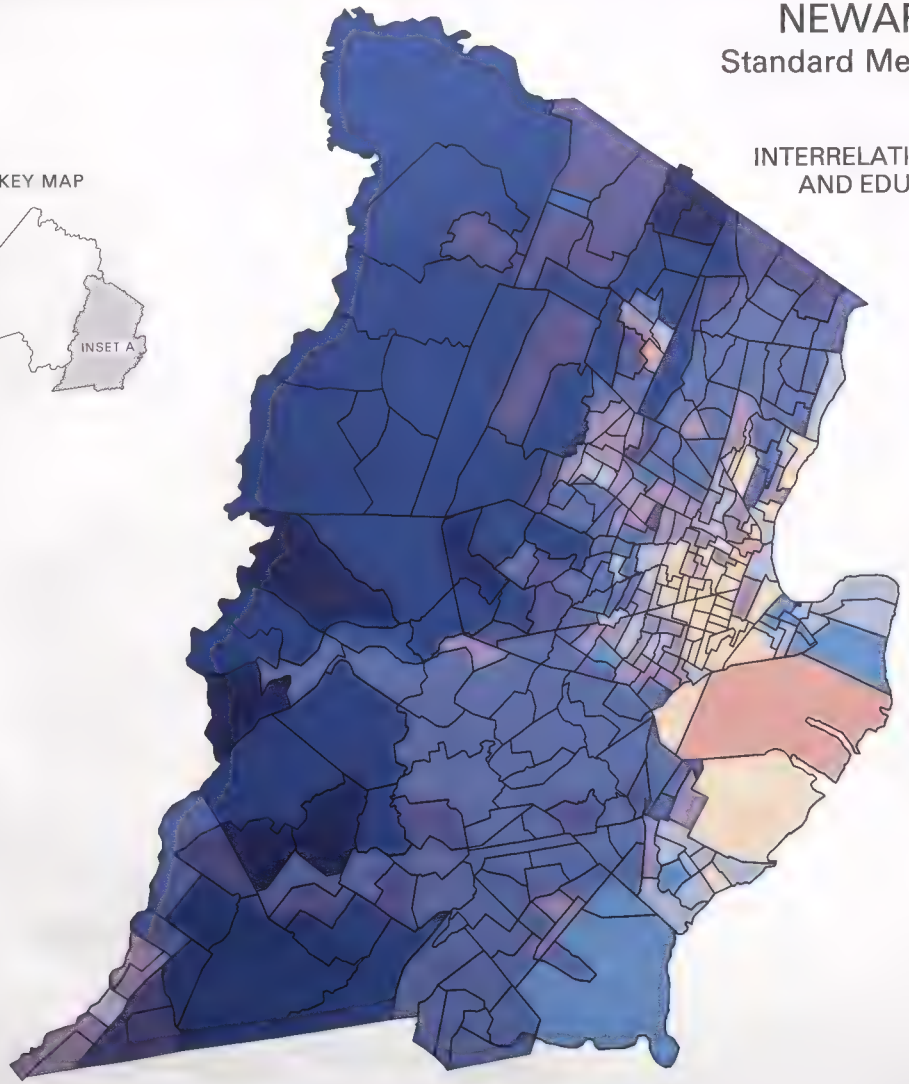
Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and, Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

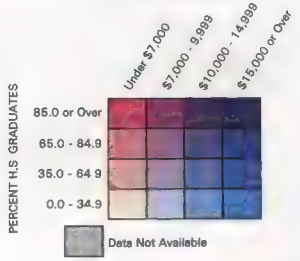
Standard Metropolitan Statistical Area
INSET A

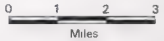
INTERRELATIONSHIP OF FAMILY INCOME AND EDUCATIONAL ATTAINMENT

KEY MAP



MEDIAN FAMILY INCOME





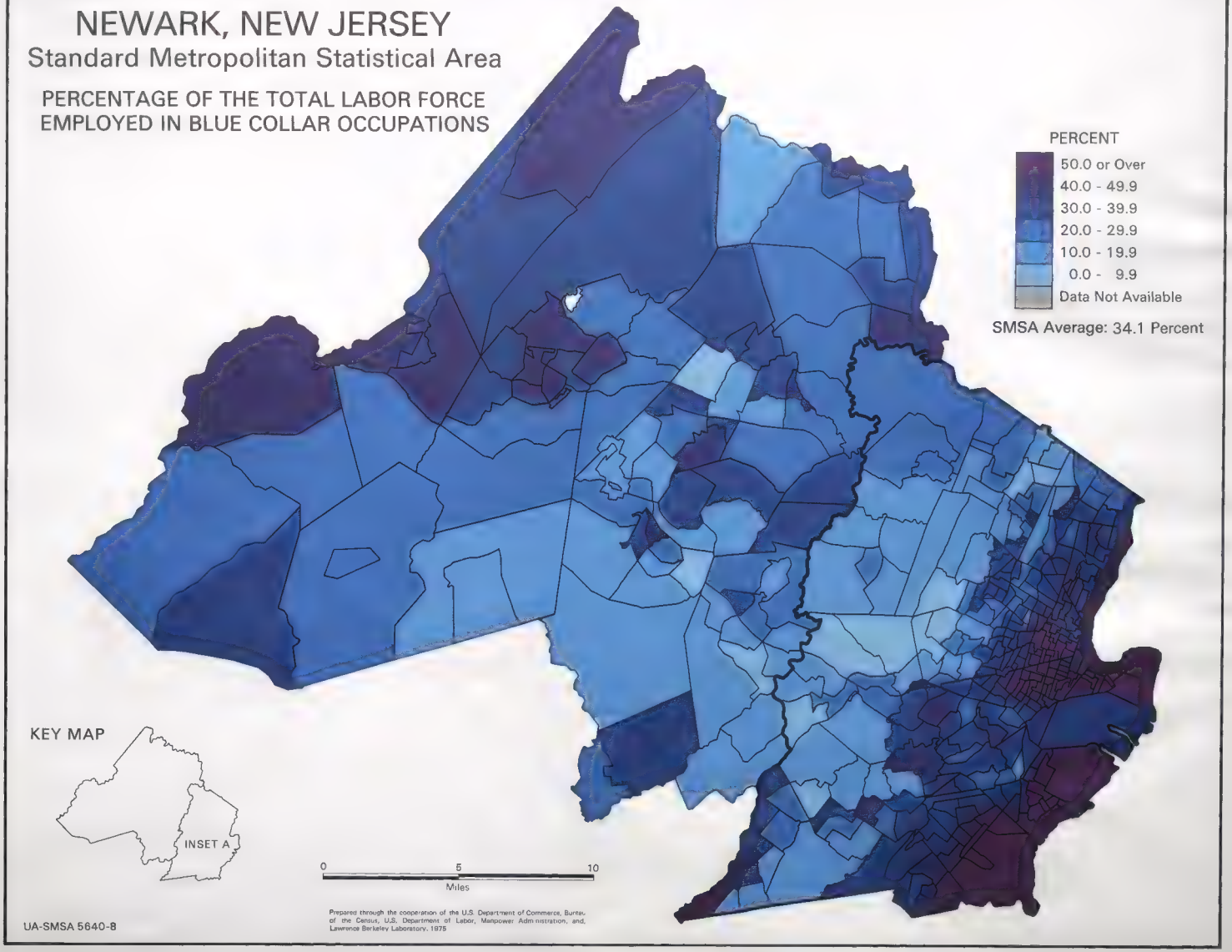
UA-SMSA 5640-7-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF THE TOTAL LABOR FORCE EMPLOYED IN BLUE COLLAR OCCUPATIONS



UA-SMSA 5640-8

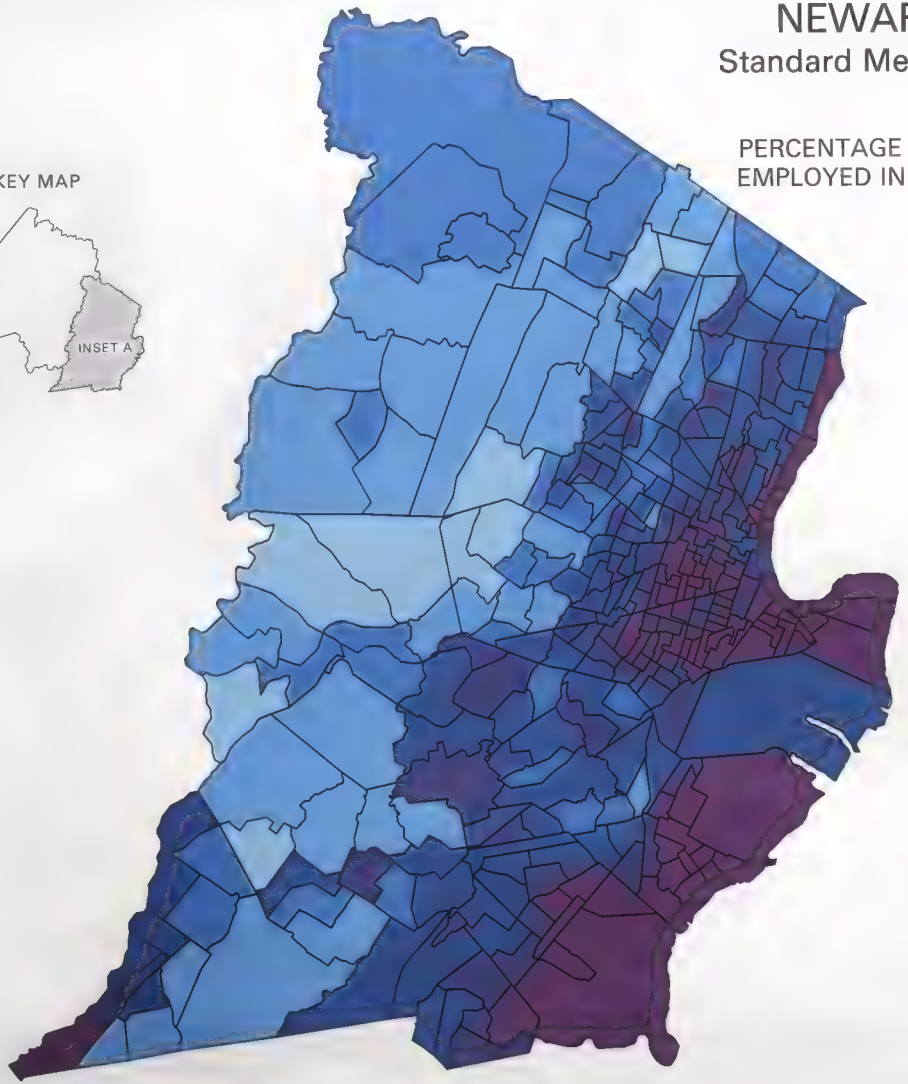
Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and, Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area
INSET A

PERCENTAGE OF THE TOTAL LABOR FORCE
EMPLOYED IN BLUE COLLAR OCCUPATIONS

KEY MAP



PERCENT

- 50.0 or Over
- 40.0 - 49.9
- 30.0 - 39.9
- 20.0 - 29.9
- 10.0 - 19.9
- 0.0 - 9.9
- Data Not Available

SMSA Average: 34.1 Percent

0 1 2 3
Miles

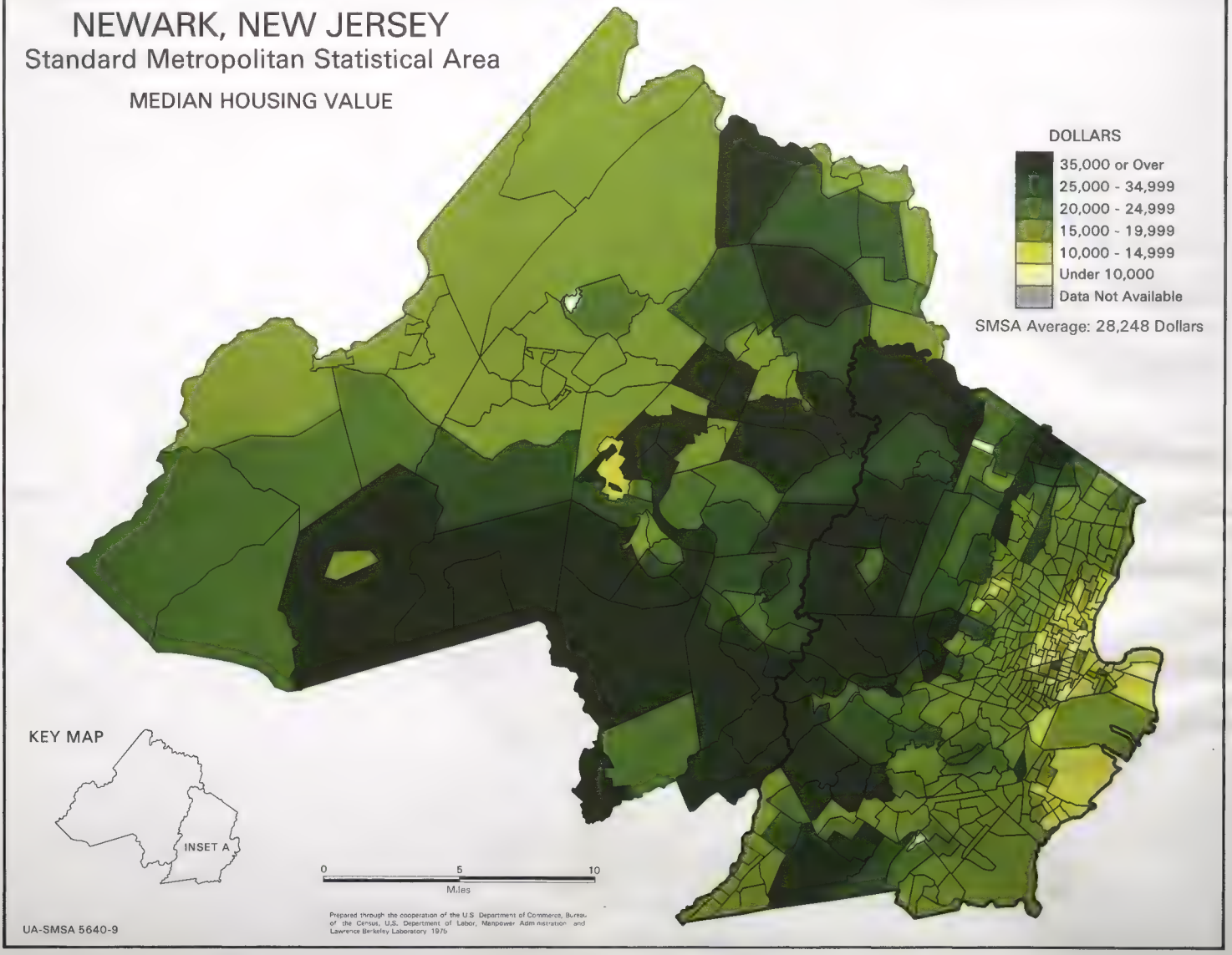
UA-SMSA 5640-8-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

MEDIAN HOUSING VALUE



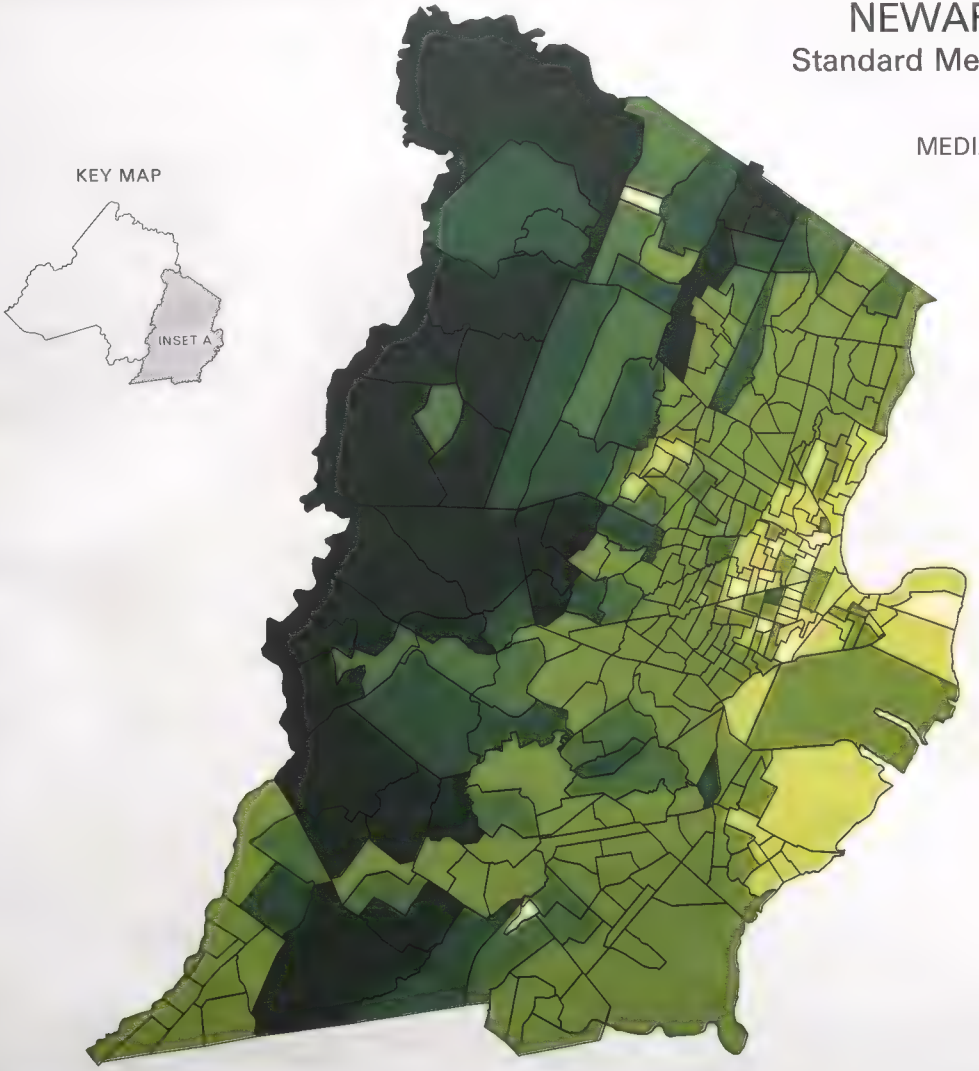
UA-SMSA 5640-9

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration and Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area
INSET A

MEDIAN HOUSING VALUE



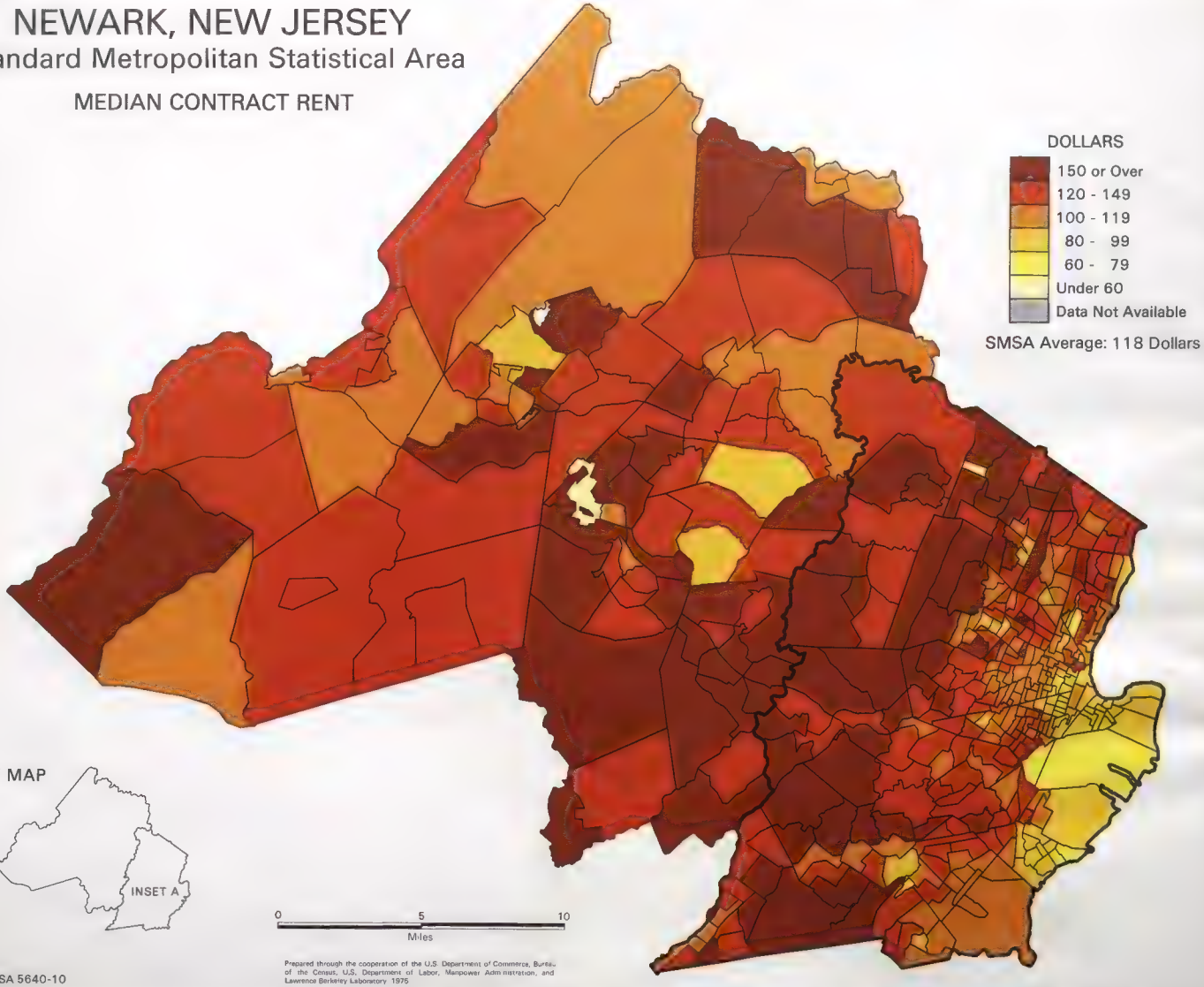
UA SMSA 5640-9-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

MEDIAN CONTRACT RENT



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory 1975

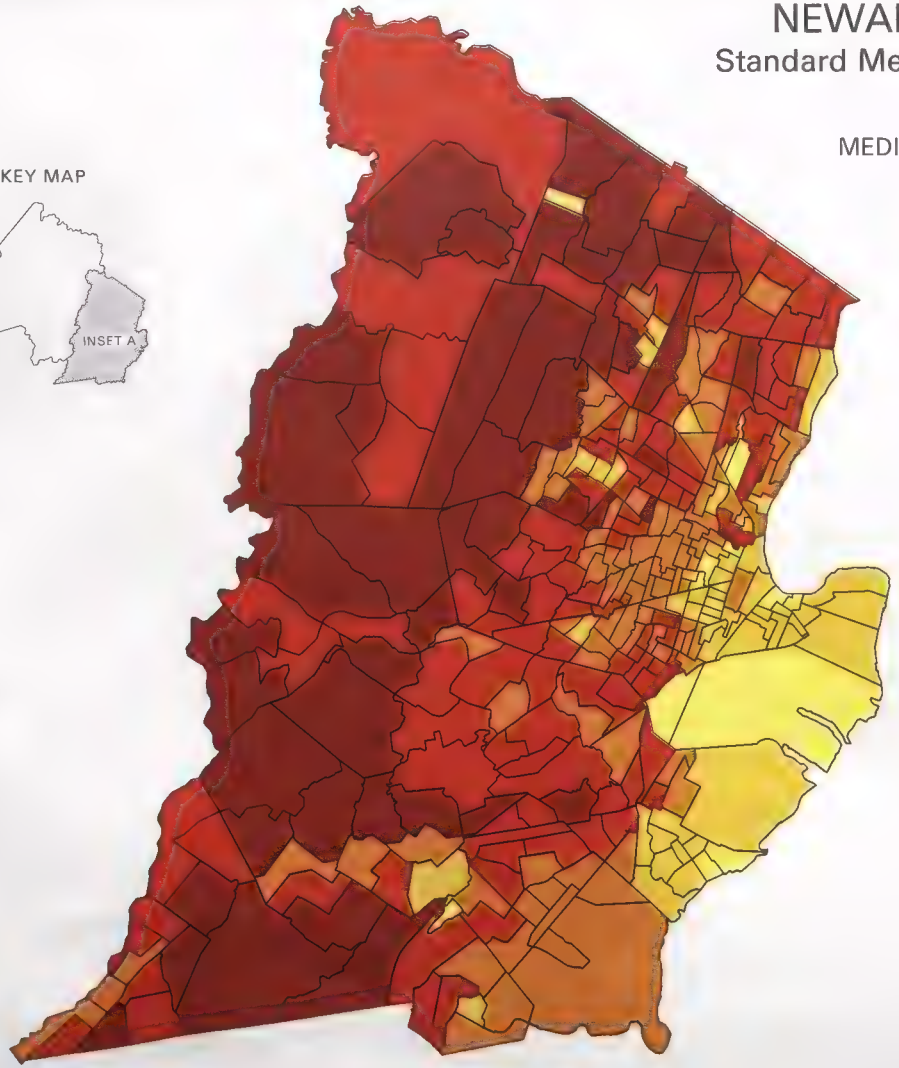
UA-SMSA 5640-10

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

MEDIAN CONTRACT RENT



DOLLARS

- 150 or Over
- 120 - 149
- 100 - 119
- 80 - 99
- 60 - 79
- Under 60
- Data Not Available

SMSA Average: 118 Dollars

0 1 2 3
Miles

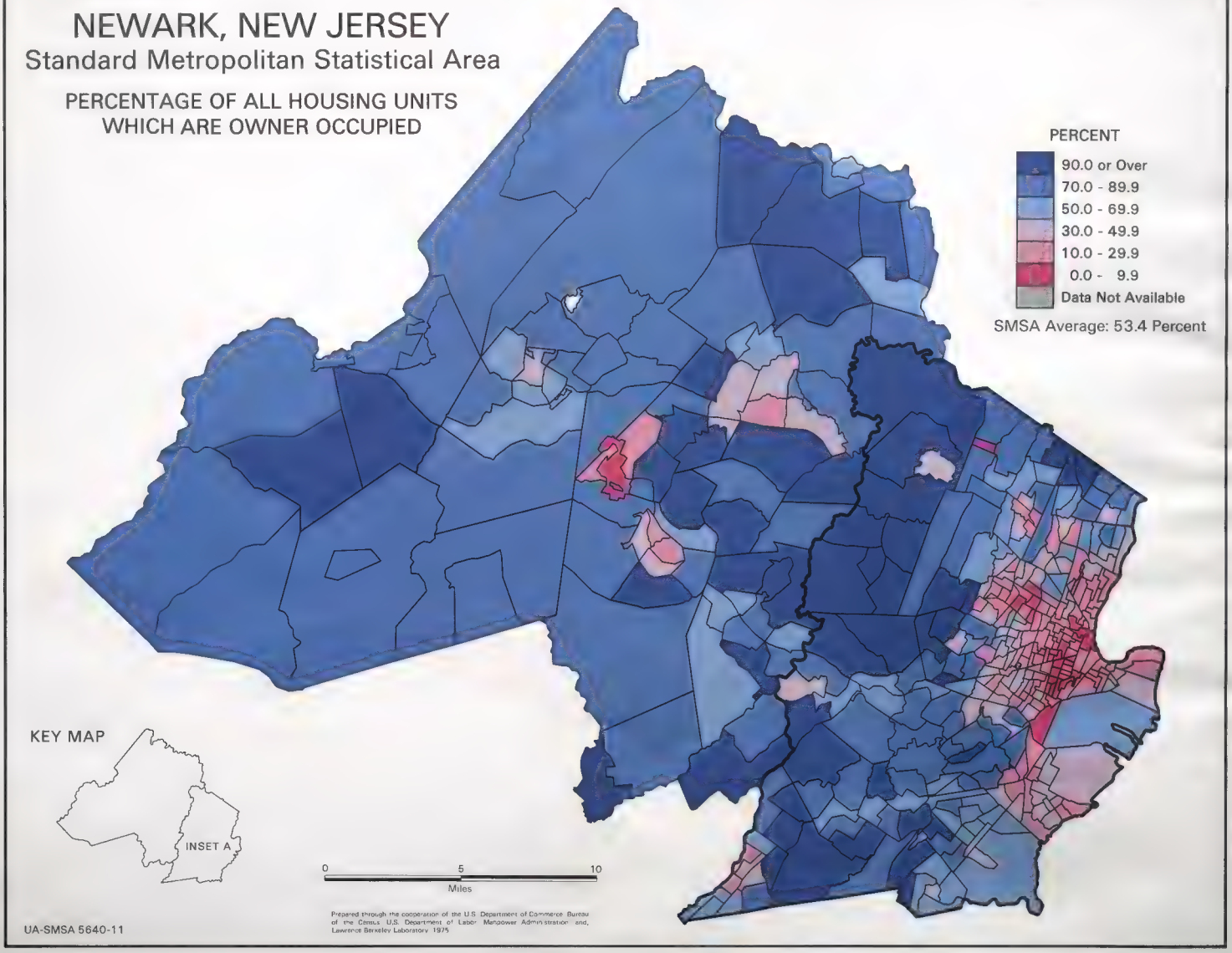
UA-SMSA 5640-10-A

Prepared through the cooperation of the U.S. Department of Commerce Bureau of the Census, U.S. Department of Labor Manpower Administration and Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF ALL HOUSING UNITS WHICH ARE OWNER OCCUPIED



Prepared through the cooperation of the U.S. Department of Commerce Bureau of the Census, U.S. Department of Labor Manpower Administration and, Lawrence Berkeley Laboratory 1975

UA-SMSA 5640-11

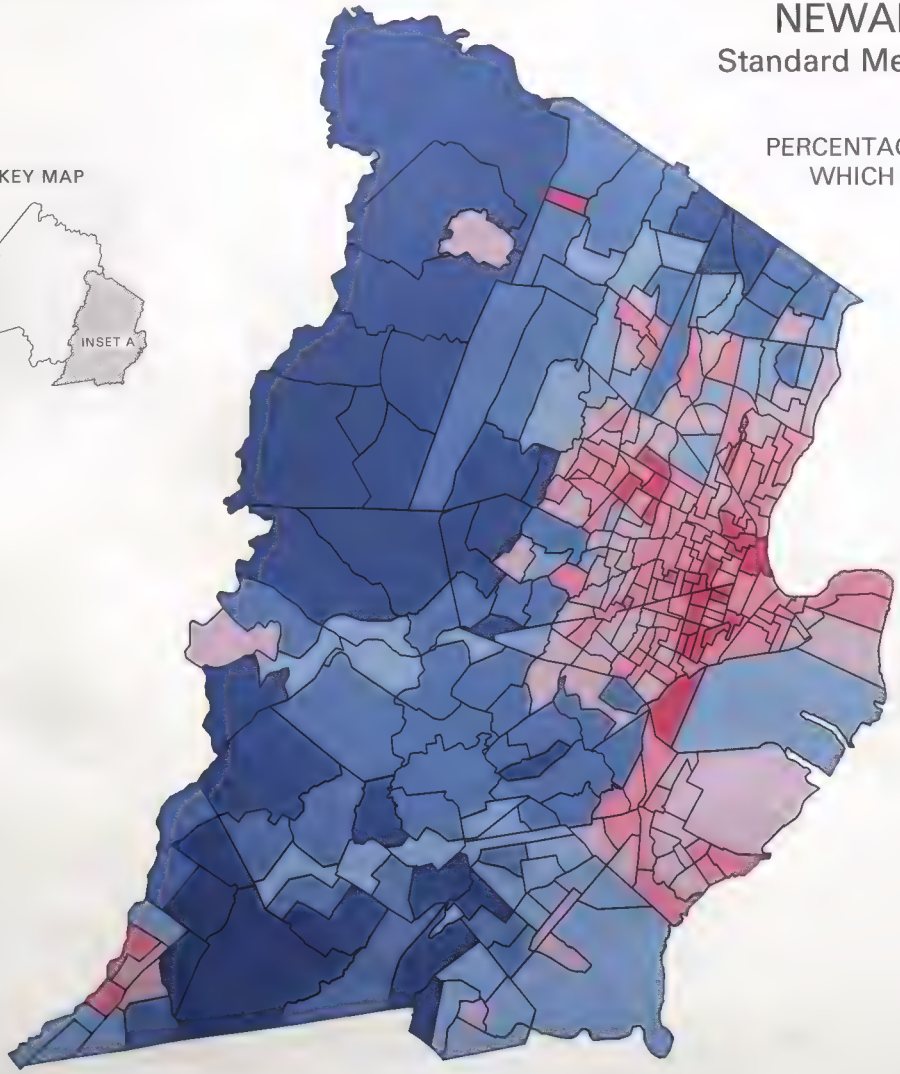
NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

INSET A

PERCENTAGE OF ALL HOUSING UNITS
WHICH ARE OWNER OCCUPIED

KEY MAP



PERCENT

- 90.0 or Over
- 70.0 - 89.9
- 50.0 - 69.9
- 30.0 - 49.9
- 10.0 - 29.9
- 0.0 - 9.9
- Data Not Available

SMSA Average: 53.4 Percent

0 1 2 3
Miles

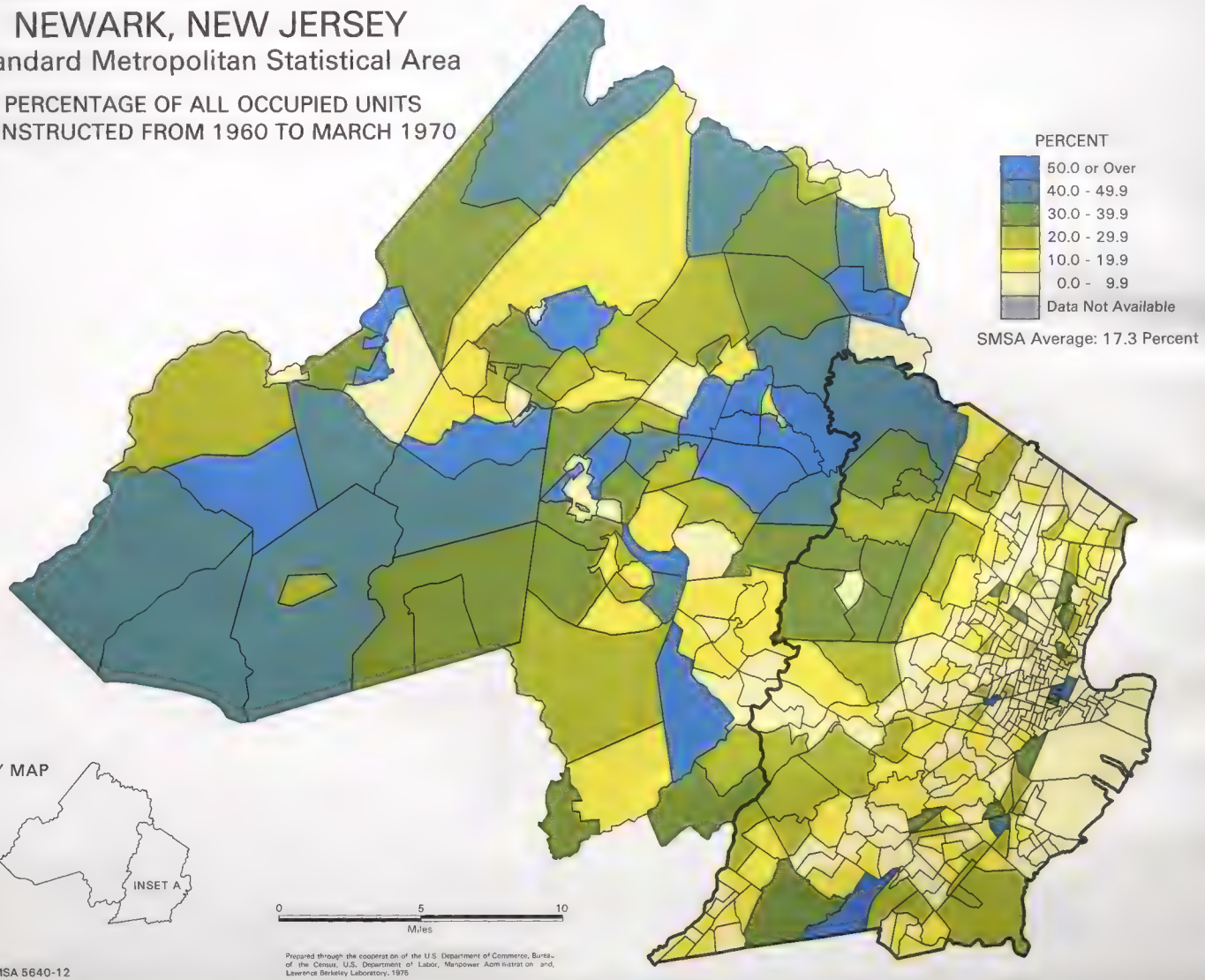
UA SMSA 5640-11-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and, Lawrence Berkeley Laboratory 1975

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area

PERCENTAGE OF ALL OCCUPIED UNITS
CONSTRUCTED FROM 1960 TO MARCH 1970



Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census, U.S. Department of Labor, Manpower Administration, and Lawrence Berkeley Laboratory, 1975

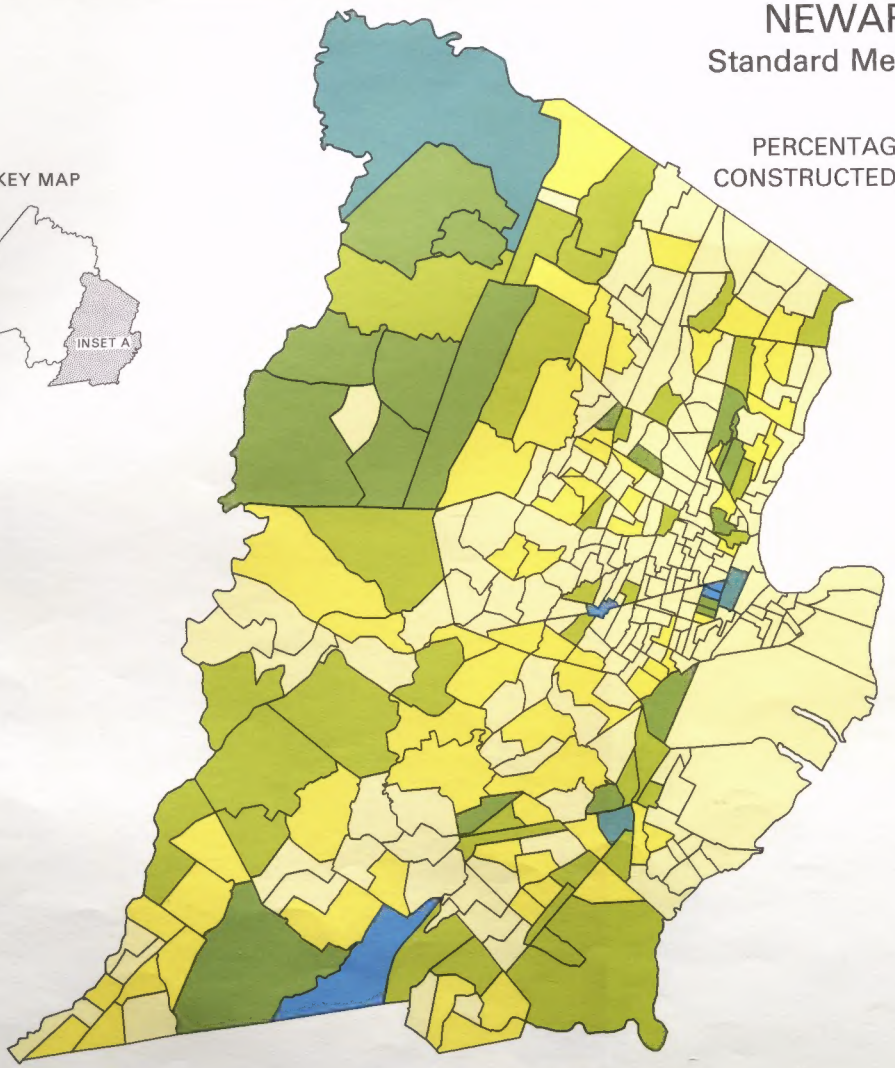
UA-SMSA 5640-12

NEWARK, NEW JERSEY

Standard Metropolitan Statistical Area
INSET A

PERCENTAGE OF ALL OCCUPIED UNITS
CONSTRUCTED FROM 1960 TO MARCH 1970

KEY MAP



PERCENT

- 50.0 or Over
- 40.0 - 49.9
- 30.0 - 39.9
- 20.0 - 29.9
- 10.0 - 19.9
- 0.0 - 9.9
- Data Not Available

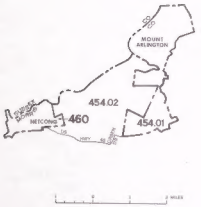
SMSA Average: 17.3 Percent

0 1 2 3
Miles

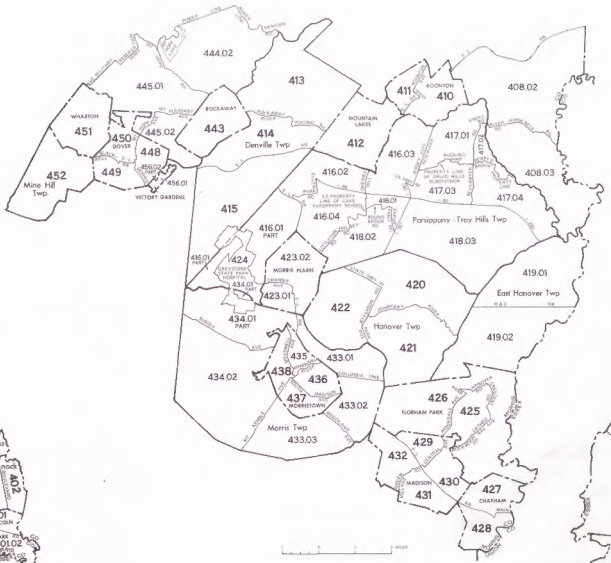
UA-SMSA 5640-12-A

Prepared through the cooperation of the U.S. Department of Commerce, Bureau of the Census; U.S. Department of Labor, Manpower Administration; and, Lawrence Berkeley Laboratory, 1976

CENSUS TRACTS IN THE NEWARK, N.J. SMSA



INSET D - MOUNT ARLINGTON AND VICINITY

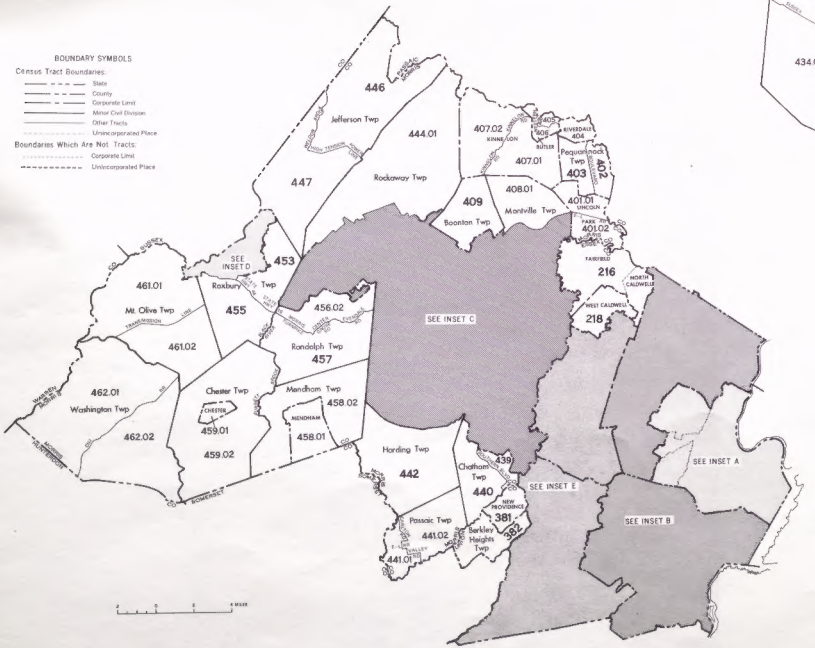


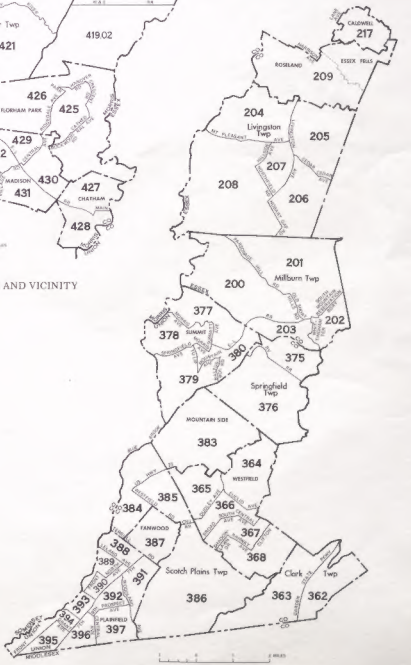
INSET C - MORRISTOWN AND VICINITY

BOUNDARY SYMBOLS

Census Tract Boundaries:
- State
- County
- Corporate Limit
- Minor Civil Division
- Other Tracts
- Unincorporated Place

Boundaries Which Are Not Tracts:
- Corporate Limit
- Unincorporated Place

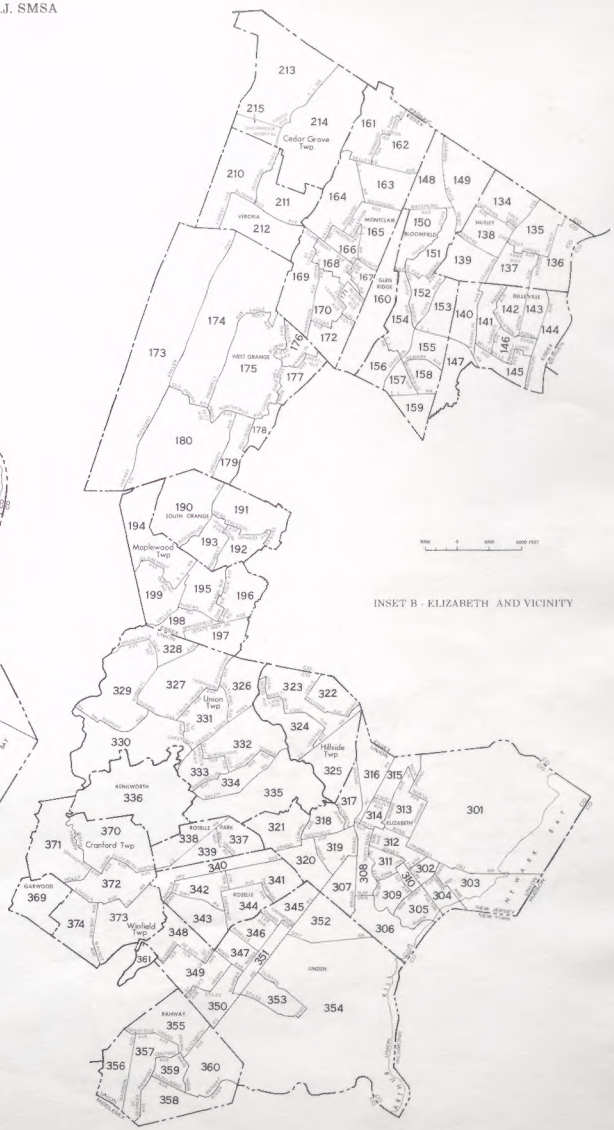




INSET E - PLAINFIELD AND VICINITY

CENSUS TRACTS IN THE NEWARK, N.J. SMSA

INSET A - NEWARK AND VICINITY



INSET B - ELIZABETH AND VICINITY

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1776-1976